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The Observation of Rayons in Polarized Light*

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In the identification of the rayons, the microscopic method has long been necessary in the cases of viscose and cupra rayons. Acetate and nitro rayons are easily distinguished by the microscope and also by chemical tests, but the identification of a rayon as viscose or cupra has depended principally upon the observations of fiber diameter and cross-section shape. With the advent of stretch-spun viscose, the determination has become more difficult because of the fact that the diameters are about the same for both types and that the shapes of both the stretch-spun viscose and the cupra rayons tend to approach the circular. Moreover, the serrated edge, once a fairly characteristic property of viscose, tends to be less and less conspicuous as the stretching process is carried further. It is desirable, therefore, that additional data be obtained to make the identification more certain, and the use of polarized light suggests itself.

SINCE the color produced by polarized light passing through a fiber is due to retardation and interference, and since the amount of retardation is known to be affected only by the refractive indices of the fiber and its thickness, the possibility exists that the retardation of rayons of the same order of thickness might be sufficiently different to give characteristic colors.

Qualitative Observations

Observations recorded in the literature show considerable diversity of results, but agree that acetate rayons show very faint or no colors by polarized light and that nitro rayons give very brilliant colors. Table I, while incomplete, will illustrate the fact that the data on viscose and cupra rayons are very contradictory. It was, therefore, decided to attempt first to determine any qualitative relationship between the type of rayon and the color produced by polarized light. Since it is at least possible that the strong colors produced by nitro rayons are due to residual nitro groups, the observations included nitro rayons as well as cupra and viscose, for it was known that the newer nitro rayons had been more completely denitrated than the older ones.

Although it has been stated[6] that polarization colors do not depend upon the refractive index of the substance as compared with the surrounding medium, preliminary tests were carried out to determine the effect of mounting media on the colors produced by polarized light. Two samples of nitro rayon were used since the colors were expected to be of a higher order and easier to differentiate. A single filament of each rayon was fastened on a slide (loosely, to prevent strain effects) at the ends and examined by a polarizing microscope at 200 × magnification in various mounting media in a position 45° to the plane of polarization. After each examination the microscope was racked up, the

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Table I—Appearance of Rayons by Polarized Light

	Acetate	*Nitro*	*Cupra*	*Viscose*
Chamot and Mason[1]	Very weak	Strong	Moderately strong	Moderately strong
Lindsley[2]	Very faint	Bright	Polarizes well	Polarizes well
Matthews[3]		Bright blue	Uniform bluish grey	Uniform bluish grey
Hanausek[4]	Inactive	Strong	Feeble	Similar to cupra but weaker
Lawrie[5]	None	Very brilliant	Plain yellow	Yellow ground with red or orange central band

TABLE II—EFFECT OF MOUNTING MEDIA ON POLARIZATION COLORS

Mounting Medium	*R.I. of Medium*	*New Type Nitro Rayon*			*Old Type Nitro Rayon*		
		Top	Center	Bottom	Top	Center	Bottom
Air	1.00	Pink	Yellow	White	Red-purple	Yellow	Blue
Water	1.33	White	Yellow	White	Yellow	Blue	Yellow
Cedar Oil	1.52	Yellow	Blue	Yellow	Blue-violet	Bright yellow	Blue-violet
Monochlor-naphthalene	1.65	Yellow	Blue	Yellow	Blue-violet	Bright yellow	Blue-violet

mounting medium blotted off with filter paper, the new mounting medium added and removed twice to displace any of the old, and examined in another mount. This was done so that the same spot on each filament should be examined and the possibility of differences in color due to differences in thickness eliminated.

The rayons appeared as broad fibres with central bands. The results of the color observations are shown in Table II. It appears that for uniform results as to colors, it would be necessary to have a mounting medium of refractive index the same as, or higher than that of the fibre. In further examinations, Canada balsam mounts were used because this medium has approximately the same refractive index as the rayons and has the further advantage of permanence.

Mounts of single filaments in Canada balsam were examined at 45° to the plane of polarization. The results are shown in Table III and may be summarized as follows:—

1. The acetate rayons show consistently dim colors which are characteristic.

TABLE III—POLARIZATION COLORS OF RAYONS TESTED

No.	*Type of Rayon*	*Date of Manufacture*	*Interference Colors*
1	Acetate A	old	Dim light colors
2	Acetate A	1930	Cream central band on light blue ground—dim
3	Acetate B	1930	Same as 2
4	Acetate C	1930	Very dim light colors
5	Nitro A	1930	Dark with light streaks
6	Nitro A delustered	1930	Blue central band on yellow ground, suspended particles—bright colors
23	Nitro B	old	Bright yellow, red, orange, blue bands
7	Cupra A	old	Uniform bright yellow
8	Cupra A	1930	Uniform bright yellow
9	Viscose A	old	Bright yellow, blue, grey-green bands
10	Viscose A, dull	old	Same as 9, but dimmer
11	Viscose B	old	Blue central band on white background
12	Viscose C	1930	Bright yellow with occasional red or blue streak
14	Viscose D	1930	Blue-grey central band on white ground
15	Viscose E	1930	Bright yellow with red or blue streaks
16	Viscose F	1930	Same as 15
17	Viscose F delustered	1930	Light yellow, suspended particles
18	Viscose, hollow filament	old	Light yellow and white shot with blue and orange
13	Stretch viscose A	1930	Dull white
19	Stretch viscose B	1931	Yellow, occasional streak of orange

2. The nitro rayons tested gave more varied results than indicated in the literature. The newer type gave much dimmer colors than the old.

3. The cupra and stretch-spun viscose specimens were very similar.

4. The ordinary viscose rayons showed great variations, sufficient to make identification difficult by qualitative observations alone.

QUANTITATIVE OBSERVATIONS

The determination of the difference between the greatest and least refractive indices of crystal-sections has long been used in petrography for the identification of crystals. The following relationship exists[7]:—

$$R/M = n_2 - n_1$$

Where R = retardation.
M = thickness.
n_2 and n_1 = greatest and least indices of refraction of the section examined.
R and M may have any units provided the same unit is used for both.

If the crystal is uniaxial and the section examined contains the optic axis $n_2 - n_1$ is a maximum, and the equation becomes:—

$$R/M = e - w.$$

e and w = greatest and least indices of refraction of the material.

R/M or $e - w$ is, then, a characteristic of the material of the crystal and is independent of the size, shape, or thickness of the particular specimen being examined.

The cellulose micelle is in the form of a monoclinic biaxial crystal. Two of the axes of the index-ellipsoid are practically equal so that the above value of $e - w$, called by Herzog[8] "specific double refraction," may be determined and will be characteristic of the uniformity of arrangement of the structural units of the particular form of cellulose. Table IV shows the results given by Chamot and Mason[9] and Table V the results obtained by Herzog[8] for various rayons.

TABLE IV—CHAMOT'S VALUES OF $e - w$

Rayon	w	e	$e - w$
Acetate	1.48	1.475	—0.005
Nitro	1.52	1.55	+0.030
Viscose	1.525	1.55	+0.025
Cupra		not reported	

TABLE V—HERZOG'S VALUES OF $\epsilon - \omega$

Rayon	ω	ϵ	$\epsilon - \omega$
Cupra—fine	1.520	1.552	0.032
Cupra—coarse	1.527	1.548	0.021
Viscose—fine	1.514	1.550	0.036
Viscose—coarse	1.523	1.548	0.025
Viscose—coarse	1.524	1.548	0.024
Nitro—fine	1.514	1.556	0.042
Nitro—fine	1.515	1.548	0.033
Nitro—coarse	1.515	1.549	0.034
Nitro—coarse	1.517	1.549	0.032

Herzog's data shows that $\epsilon - \omega$ is so nearly the same for cupra and viscose rayons manufactured similarly (with or without stretch-spinning) that the method would be of little value for identification, but since this work had been nearly completed at the time of publication of Herzog's data, it was decided to extend the results to a greater number of rayons for more complete verification.

A polarizing, chemical microscope with cross hairs fixed in the plane of polarization and perpendicular to it was used and the refractive indices were determined by the immersion method described by Preston[10] using the microscope without the analyzer. A filament was mounted in one medium, focussed, and brought parallel to one cross hair. The microscope was then focussed upward slightly and the position of the Becke line noted. The Becke line is a bright line running along the outline of the filament inside the outline if the fibre has the higher refractive index and outside if the liquid has the higher refractive index. Additional mounts were made as indicated by the Becke line position until a liquid was found in which the filament was invisible and in which there was no Becke line. Liquids varying by 0.005 in refractive index were used; they were prepared as in Table VI and were calibrated with an Abbé refractometer.

The values obtained for $\epsilon - \omega$ are shown in Table VII and may be summarized as follows:—

1. The value of $\epsilon - \omega$ for each type of rayon is characteristic of the type of rayon, being .030 for nitro rayons, .015 for viscose rayons, .020 to .025 for stretch-spun viscose, and .020 to 0.25 for cupra rayons (also stretch-spun).

TABLE VI—PREPARATION OF STANDARD MEDIA

Refractive Index	*Pine Oil c.cm.*	*Nitrobenzene c.cm.*	*Aniline c.cm.*
1.510	15.0	10.0	—
1.515	11.0	10.0	—
1.520	10.0	12.8	—
1.525	10.0	17.0	—
1.530	8.5	20.0	—
1.535	7.0	24.6	—
1.540	3.5	20.0	—
1.545	1.6	20.0	—
1.550	—	25.0	—
1.555	—	14.0	3.1
1.560	—	11.5	5.7
1.565	—	9.0	9.0

TABLE VII—EXPERIMENTAL VALUES OF $\epsilon - \omega$

No.	*Type*	*Date*	*Denier per Filament*	ω	ϵ	$\epsilon - \omega$
23	Nitro A	old	—	1.515	1.545	0.030
5	Nitro B	1930	—	1.525	1.555	0.030
27	Nitro B	1931	5.00	1.520	1.550	0.030
28	Nitro B	1931	3.84	1.520	1.550	0.030
31	Nitro B dull	1931	3.84	1.510	1.540	0.030
18	Hollow filament viscose	old	—	1.520	1.540	0.020
11	Viscose A	old	—	1.525	1.540	0.015
12	Viscose B	1930	—	1.525	1.540	0.015
14	Viscose C	1930	—	1.525	1.540	0.015
15	Viscose D	1930	—	1.520	1.535	0.015
16	Viscose E	1930	—	1.525	1.540	0.015
35	Viscose F	1931	3.75	1.525	1.540	0.015
19	Stretch Viscose A	1931	—	1.520	1.540	0.020
13	Stretch Viscose B	1930	—	1.520	1.545	0.025
36	Stretch Viscose B	1931	—	1.520	1.545	0.025
7	Cupra A	old	—	1.525	1.545	0.020
8	Cupra A	1930	—	1.520	1.545	0.025

2. The absolute values of ϵ and ω seem to be dependent upon the details of manufacture.

3. In the case of nitro rayon, the value of $\epsilon - \omega$ is constant for all samples observed in spite of the fact that the amount of residual nitration as qualitatively observed by diphenylamine tests decreased in the order—old, 1930, 1931.

4. Stretch-spun viscose and cupra cannot be distinguished by the $\epsilon - \omega$ value.

5. Comparison of samples 27 and 28 shows that differences in thickness of the filaments not due to differences in manufacture have no effect on the optical properties of the rayon.

A possible application of observations by polarized light lies in obtaining the degree to which the cross-section of the rayon approximates a true circle. Since $R/M = \epsilon - \omega$, then $M = R/\epsilon - \omega$, and the thickness may be calculated if $\epsilon - \omega$ is measured or known and if R is known. R may be determined by observing the color by polarized light of highest value and consulting the Newton Color Scale or may be measured accurately by means of a compensating wedge. If the thickness is known and the breadth is measured, the ratio expresses the approximation to a circle of the cross-section. Illustrations of results obtained in this manner are given in Table VIII. Observations of this type would be very useful in determining the uniformity of rayons in many instances, since a single filament could be examined at intervals along its length without the use of cross-sections. The observations necessary are diameter, color of the highest order, and the double refraction of the rayon. This last quantity need be determined only once for each sample of rayon.

GENERAL CONCLUSIONS

1. The value of the specific double refraction may be used to distinguish between various types of rayon with the exception that it does not distinguish between stretch-spun viscose and stretch-spun cupra rayons.

2. The specific double refraction is little affected by residual nitro groups left in nitro rayons.

TABLE VIII—DETERMINATION OF DEVIATION FROM CIRCULAR

Sample No.	*Type*	*Date*	*Breadth- microns*	*Color When the Nicols Are Crossed*	*Parallel*	*B from Newton's Color Scale -microns*	*e —w*	*Thickness -microns*	*Thickness ÷ Breadth*	*% deviation from circular*
19	Stretch viscose A	1931	16.2	light yellow	blue	.306	.020	15.3	0.944	5.6
13	Stretch viscose B	1930	15.0	blue grey	yellow brown	.218	0.25	8.7	0.580	42.0
36	Stretch viscose B	1931	8.9	yellow	blue	.332	.025	13.3	1.474	47.4
7	Cupra A	old	12.2	light yellow	blue	.305	.020	15.3	1.254	25.4
8	Cupra A	1930	13.0	bright yellow	blue	.332	.025	13.3	1.023	2.3

3. Differences in thickness of the rayons have no effect on the specific double refraction of rayon except when the difference in thickness is due to stretch-spinning.

4. The specific double refraction of a rayon in conjunction with two other easily determined observations may be used to determine the deviation of the cross-section of the rayon from the circular and this last value may be used as a measure of the uniformity of the rayon.

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Cyanamid Golf Tournament

One of the most successful and best attended annual spring outing and golf tournaments ever held by the American Cyanamid Company and associate companies took place Saturday, May 21st, at the Blue Hill Country Club, Pearl River, N. Y.

The attendance from the parent and associate companies was about 120 and all took an active part in the tournament and other festivities. The following units were among those represented:

Kalbfleisch Corp., Calco Chemical Co., Structural Gypsum Co., A. Klipstein & Co., Inc., J. C. Wiarda Co., Lederle Laboratories, Heller & Merz, Beetleware Corp., Arizona Chemical Co.

Leucothol

Leucothol Stripper is a titanus salt in which the greatest amount of available reducing agent is held in solution. Being in a stable liquid solution, it requires no dissolving. This material is a reducing agent by reason of its direct affinity for the dyestuffs.

Leucothol has the same percentage bearing to a dyestuff, or requires the same given amount of material to react with a dyestuff, as it would for an acid to react with an alkali. The reaction cannot be dissipated except by the addition of a dyestuff. Stripping action of Leucothol is continued almost to a point of the liquid of the bath being dissipated.

Leucothol Stripper is said to strip all acid and direct colors. There are some chloramine yellows that are not stripped by other strippers, but, according to the manufacturers, can be reduced with Leucothol.

This product is said to work equally well on cotton, rayon, silk, worsted, wool, mixed fabrics, piece goods, hosiery or yarns. It can be used at temperatures from 140° F. up to the boil.

Bismarck Brown in Aniline Black Dyeing

Dr. H.—Deutscher Faerber-Ztg. 67,168 (1931)—The question of being able to diminish the amount of aniline in aniline-black dyeing is of doubly interesting nature (Rev. gen. mat. col.). If it were possible, there would be these two advantages; the lessening of the amount of harmful aniline vapors escaping into the working-atmosphere, and the decrease in amount of mineral acid in the dyed goods, which latter would be advantageous in decreasing the danger of tendering of the goods. A proposal in this direction involves the use of catalysts, which, however, as a class, have been used for some time in various guises. The particular method now proposed, by Feigin, consists in the use of Bismarck Brown as a catalyst. He has shown that the oxidation of the aniline is actually considerably favored, and that a fuller black can be obtained by its use, even when the amount of aniline is decreased. The increase in the strength of the black is not due to any dyeing-effect of the Bismarck Brown, for the amount of this dyestuff used is very small. Practically, the use of it permits a decrease of 8-18% of the constituents of the mixture. For example, the cloth is padded upon a 3-roll Foulard with a mixture of 20 g. of aniline, 37 g. of hydrochloric acid of 19° B., 14 g. of chlorate, 4 g. of crystallized copper sulphate, 3.4 g. of formic acid, and 0.28 g. of Bismarck Brown; the color is then developed upon a Preisbich broad-dyeing machine. The goods are chromed, left for two hours, and again chromed at 30° C. Then follows treatment with a soda bath (2-1000), at 85° C., the goods being then washed and dried. A special advantage of the process lies in the fact that the tensile strength of the fabric suffers by 8-18% less than is the case with other methods of dyeing the black.

Effectiveness of Silicon in Weighting and Bleaching

By Benjamin Levitt, F.A.I.C.

SILICON, though one of the most widely distributed elements, is never found in its free state, but always as the oxide (SiO_2) or in the form of silicates. Silica and silicates are the chief components of the earth's crust. According to Clarke, Bull. U. S. Geologic Survey, 1904, silica constitutes 60% of the lithosphere. Quartz, sand, amethyst, opal, jasper and diatomaceous earth are forms of silica existing in nature. There is a large variety of silicates which includes all rocks.

Pure silicon is manufactured by melting a mixture of quartz, sand and crushed coke at 3000° C. in the arc type of electric furnace. The pure metal collects at the bottom. This is known as the Atcheson process. It is used in the manufacture of steel. Silicon steel is very efficient for use in magnets on account of its high electrical resistance.

Silicon carbide or, as it is popularly known, carborundum, is manufactured by fusing a mixture of sand, coke and salt in an electric furnace, with the following resultant reaction—

$SiO_2 + 3\,C = SiC + 2\,CO$

sand + carbon = sil. carbide + carbon monoxide

The crystals of silicon carbide are almost as hard as diamond, and for this reason, it is used for making grindstones and for polishing compounds.

The silicates of soda are the compounds of greatest interest to the textile industry. Briefly, they are produced by fusing sand with soda ash.

$SiO_2 + Na_2CO_3 = Na_2Si\,O_3 + CO_2$

sand soda ash sod. silicate carbon dioxide

By varying the proportions of soda ash and sand, silicates can be produced with greater or less alkalinity.

Boil-Off Oils

Combinations of sodium silicates and sulphonated oils are sold on the market as boil-off oils. These are useful because of the property of silicate to buffer the effect of other alkalies. In other words, the pH level at which the boil-off is started, is continued over a longer period of time than in a solution of alkali which contains no silicate. The silk is therefore not attacked by free alkali, but is liberated as required to maintain a bath just active enough to free the silk of sericin. The sulphonated oil prevents "nigger-heads" that is the precipitation of calcium and magnesia.

Weighting Silk

Sodium silicate is also used in weighting silk. In this process which really consists of five distinct changes, through which the fabric to be weighted undergoes, namely, degumming in a soap bath, washing the goods in a 2% soda solution, loading with stannic chloride, hydrolysis of the tin chloride, phosphating with disodium phosphate, the goods are given a final silicating in a 0.5 to 2.5 Be sodium silicate so that when finished a tin silico-phosphate is fixed in the fabric.

Bleaching Silk

In bleaching of silk hosiery by the two bath method, the goods are first degummed and bleached in a bath consisting of 6 pounds of soap and 1 pound silicate of soda to each 100 gallons of water, boiling off for an hour at 195°F. The goods are then steeped in the bleach bath prepared by adding one gallon Albone C or equivalent peroxide and 6 pounds of silicate of soda to each 100 gallons water. The silicate in such a bath acts as a buffering agent to check too rapid a decomposition of the hydrogen peroxide.

Mordanting

In mordanting acetate silk with tin, the goods are treated in a bath of 20°Be (1.16 Sp. Gr.) tin chloride solution. After washing with water, it is treated with a 2°Be silicate solution. A second treatment may be given and the fabric again washed.

Silicate as Bleacher's Assistant

Matthews—"Bleaching and Related Processes," says that sodium silicate is rather extensively used in the preparation of bleacher's assistants to be used in boiling out cotton in the kier. It also finds favor with a number of bleachers as an addition to the kier boil in connection with caustic soda and soda ash. It is said to give the goods a softer feel.

German patent No. 527,032 states that iron kiers etc. used for boiling textiles with alkali are lined with a thin layer of a lime cement mixture containing 50 to 80% lime, with or without magnesium oxide. The lining may be treated with a boiling

solution of alkali silicate and carbonate before it has fully dried. The lining renders vessels suitable for use in peroxide bleaching processes.

Boiler Compounds

Silicate of soda is one of the basic ingredients in many boiler compounds. It softens the water by combining with calcium, magnesium, iron and aluminum salts which it precipitates as flocculent insoluble silicates. These may then be "blown off" periodically. On account of its colloidal nature, silicate removes existing boiler scale, and prevents further deposition. The grade most suitable for this purpose is a very alkaline silicate. The Philadelphia Quartz Co. recommends a daily addition of 1 to 1¼ pounds of their "Boiler Brand" silicate per grain of hardness in the water for each 100 H.P. ordinarily developed.

Water Softeners

Zeolites are of two kinds, natural and artificial, but are essentially of similar composition, namely, sodium aluminum silicate. Greensand is the form of zeolite found in nature. The artificial zeolite having the approximate formula Na_2O, Al_2O_3, 5 SiO_2 is prepared by gelation of sodium silicate with sodium aluminate, drying and washing to remove soluble sodium salts. Zeolites are known as base exchanging minerals, which have the property of softening water.

In combining with calcium and magnesium, they lose this softening property and must be regenerated. This means that brine is permitted to flow through the mineral, thereby dissolving the calcium and magnesium compounds and again returning to their original form as sodium aluminum silicate. Every textile mill should be equipped with a water softening system so as to have water of zero hardness for the boilers as well as for the processes.

Although zeolites last indefinitely, there is always some loss of the mineral in back washing during regeneration. The writer recently examined a system in which there had been a loss of about a foot depth of minerals. Therefore, the system should be examined at least once a year to see if the mineral is at the original level. Loss of mineral, of course, means a decrease in water softening capacity.

Silicate in Soap

Silicate of soda being an alkali, has very good detergent properties besides. It is therefore used to a great extent in the manufacture of household as well as mill soaps, where a completely neutral soap is not absolutely required.

Just as are other alkalies added to soap baths, silicate too is a soap builder. It has been shown that silicate promotes the lathering power of soap; it softens water, and neutralizes any acidity in the fabric whether it be due to perspiration or mineral acids from previous treatments. The presence of the alkaline silicate does not permit the immediate decomposition of the soap itself. The colloidal properties of the silicate additions to soap, promote emulsification of fats, oils, waxes or gums that may be present in the fabric being washed or boiled off.

Soaps containing silicate of soda are usually cheaper than those without it. However, there are many other properties by which price is governed.

Of all chemical compounds produced, sodium silicate seems to have the greatest multiplicity of uses. In anhydrous form it finds use in the ceramic industry. In liquid form, it is useful for sizing and for adhesives. It is used for fire proofing flannelette, as a mordant in cotton dyeing, and for dressing cotton warps. It is used for sizing oil barrels, lard tubs, paper cartons, for uniting corrugated paper and wall board.

Sodium Metasilicate

If two molecules of sodium bicarbonate are fused with one molecule of sand, sodium metasilicate is formed. This compound is about the strongest alkaline form of silicate. It finds use in laundries as a soap builder, in dairies for bottle washing, cleaning of metals, in paper mills for boiling operation and for paint removal from rags.

Its makers recommend its use in Clauder Weldon machines for wool scouring, in equal parts with soap in concentrations of 2 to 3% on the weight of yarn.

Silica Gel

Silica Gel is the product of a reaction between sodium silicate and an acid. The result, is silica (SiO_2) of great capillarity. It consists of minute sponge-like particles which have a very large surface area. It is said that one cubic inch of this gel has an internal surface of over one acre. The function of silica gel is to harness the force of capillary attraction just as the dynamo harnesses the force of electricity.

By adsorption, we mean the power of a substance to attract other substances to its surface. For example, silica gel will absorb or take water vapor to the extent of 40% of its own weight. It may then be used and in fact, actually is used as a dehydrating agent.

Silica gel will adsorb moisture, impurities and odors from gases passed through it. It may then be reactivated by heating to drive off the adsorbed substances, and in this way it is used over and over again.

In the manufacture of CO_2 for carbonating beverages, and also in the manufacture of solid CO_2 (dry ice), silica gel is used to dehydrate the gas and to remove impurities. The extent to which it is used for this purpose alone may be indicated by mentioning that over 80 million pounds of CO_2 are treated annually. Silica gel is also used for dehydrating the air for blast furnaces.

It can be used to regulate humidity in industrial plants, hospitals, and households. Iceless railroad,

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Spray Dyeing*

By J. D. WHITEMAN

The uses and limitations of spray guns in textile dyeing and printing are discussed in this article.

SPRAY dyeing consists simply of the complete atomization of dye solutions, these being sprayed on to the material either freehand or through stencils, by compressed air through a spray gun. The spray gun used for dyeing is exactly simliar in principle to the guns widely used for painting articles from toys to ships, while the artist's small air brush is standard equipment in practically every commercial studio. In fact, spraying is the standard method of finishing in a large number of industries, and this extremely efficient and economical process is rapidly coming to the fore also in the application of dyestuffs.

The spray gun is the most important item of equipment, and the F.P. model is the one principally used in the dyeing and cleaning and fabric-printing industries (Fig. 1). The liquid dye solution is placed in the color container, which is fitted at the side of the gun, so that the operator can see exactly what he is doing, even on the most intricate work. The color container is adjustable so that it may be set at any desired angle, according to whether the operator is working vertically or horizontally.

The apex of the cone-spray being at the nozzle, the nearer the gun is held to the surface to be decorated the smaller is the area covered, and conversely, when the gun is held farther from the surface the area covered is proportionately greater.

Two other models also are widely used in the dyeing industry. The "C" model air brush is small, and is used for spotting and other delicate operations, whereas the Superplus gun is used for covering large surfaces. It produces either a wide, vertical, or horizontal fan spray, or a round concentrated spray, by simply turning the air cap with the fingers. The selection of the right type of gun for the particular work to be done is a matter of vital importance.

The F.P. model is used where relatively small quantities of different colors are to be applied, and the dye solution is consequently frequently changed. The small container directly attached to the gun is then ideal, but if large quantities of the same solution are to be applied, the gun is connected to a 2-, 4-, or 8-gal. pressure feed container by two lengths of hose—one for the compressed air and one for the dye solution. An alternative method is to connect the gun by a length of hose to a large overhead gravity container.

An air compressor provides motive force for automizing and applying the dye solution. The pressure required does not exceed 35 lbs. to 45 lbs. per sq. in. unless the material is very thick. The compressor is provided with a regulating device which automatically keeps the pressure uniform—*a sine qua non* if the best results are to be obtained.

Compressed air invariably contains a certain amount of condensed moisture, as well as oil and dirt, and these must be removed if a satisfactory finish is to be obtained. The compressed air therefore passes through an air purifier and regulator after leaving the air receiver, which ensures a supply of clean and dry compressed air at the spray gun. The air purifier and regulator also permit the operator to vary the pressure instantly for different materials by simply turning a valve on the instrument to the right for higher pressure, or to the left for lower pressure. It is fitted with two pressure gauges indicating the regulated air pressure, and also the main air pressure from the air compressor (Fig. 2).

The spray gun is connected directly to the air purifier by means of rubber air hose. The air consumption of a spray gun and the output of an air compressor are usually expressed in terms of cubic feet per minute, and it is essential that the air compressor should provide the

*Journal Society of Dyers and Colorists.

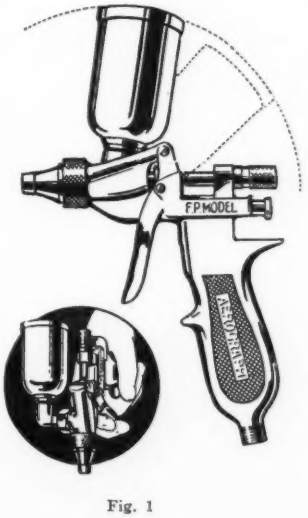

Fig. 1

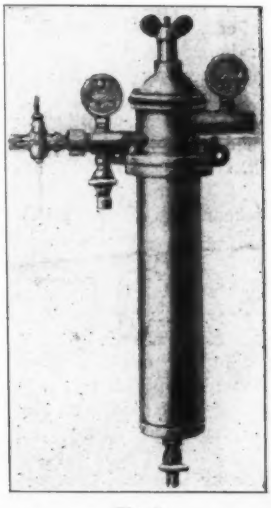

Fig. 2

necessary volume of air at the required pressure to meet the consumption of the spray gun. If the volume is insufficient the pressure will rapidly fall, with the result that the dye solution is imperfectly atomized.

In continuous work it is necessary to remove the fumes by an exhaust fan placed at the back of the operator's table, and for such work a spray booth or cabinet is usually employed. This localizes the fumes, which are removed by an exhaust fan at the back. The spray booth ensures maximum comfort and convenience for the operator.

Long experience in a great variety of industries has shown that one man using a spray gun can do at least five, and often as much as ten, times more work than he can do by hand methods. For example, a leather hide measuring 9 ft. x 8 ft. can be perfectly treated with the spray gun in about 1½ mins., whereas it usually takes two men with swabs about 7 mins. Also, two sprayed coats are usually equal in evenness and uniformity to three coats applied by hand methods.

The solution is blown gently on to the surface in atomized particles and forced into the work with a thoroughness that careful efforts by other methods often fail to accomplish.

A special advantage of the spraying method in fabric printing is that it produces superb gradations of tone, blending of colors, or ombre effects, and in this field it stands quite supreme. The color is applied with such evenness and delicacy that an almost invisible shade may be produced when commencing, which can then be gradually intensified until the exact density required is obtained —this by simple manipulation of the trigger of the gun, and without remixing or altering the color in any way. Thus, a relatively inexperienced operator can pass with ease from a tint so light that the eye cannot distinguish its termination, to a deep shade. One color may be superimposed on another without fear of irregularity, and thus two primary colors may be so perfectly blended as to produce very pure secondary tints.

In the dyeing and cleaning industry the use of compressed-air spray guns is now general. Spray guns are principally used for: (a) Spotting; (b) tinting and matching up after cleaning—e.g., quite wonderful effects are being obtained by some firms in matching up worn places on leather coats, using a cellulose solution; (c) damping; (d) application of starch and other stiffening solutions. The renovation of carpets is particularly interesting, the pattern being renewed where faded by spraying in the necessary colors with a small air brush.

For fabric decoration spraying is principally done on silk, satin, crepe de chine, voile, artificial silk, velvet, and wool; but also to a certain extent on cotton and linen. Some particularly beautiful effects are obtained on velvet and plush.

Spray Printing

When the subject of textile printing is referred to, one thinks of those great firms in Lancashire and elsewhere with plant for printing with engraved copper rollers or plates, or equipment for machine block printing. Spray printing has been done chiefly on the Continent and in and around London, on such articles as neckties, tablecloths, cushion covers, sideboard and table runners, ladies' scarfs, shawls, bathing wraps, stockings, glove borders, kimonos, jumpers, lingerie, hats, etc. In India the spray gun is used for the stencil printing of fine cotton muslin, voile, and silk Saris, either purely sprayed or in combination with hand block printing, and beautiful work is carried out also by Indian labor on blankets, rugs, and curtains.

The chief use of the spray gun in the decoration of fabrics lies in the immense variety of effects it will produce and its greater handiness for obtaining all kinds of "fancy" effects very rapidly.

It is not claimed that it is a commercial proposition for treating piece-goods on a production basis, but considerable experimenting is going on, and a few automatic installations have been supplied where the sprays are fixed and the material travels under them. The fixing of the dyes after spraying is done in the usual way—e.g., by steaming. Good effects are being obtained in discharge printing with the spray gun, through stencils.

Materials Used

It is essential that the dyestuff used in spraying should be completely soluble, to avoid small floating particles, which would tend to choke the spray gun—and it is in any case a wise precaution always to strain the material into the container of the gun. The thickeners usually employed in the dyeing industry should not form part of a spraying solution, as they tend to stop up the gun rapidly, but a certain amount of gum or shellac is useful to prevent the liquid "running" or "sagging" if carelessly sprayed. When using direct colors which tend to "run" slightly, more gum may be added, but the viscosity of the solution must not be increased unduly, or it will not flow through the gun readily. The solution must atomize completely at a reasonable pressure—e.g., 35 lbs. to 45 lbs. per sq. in.

Cellulose colors are ideal for spray dyeing, being quite flexible, drying almost immediately, and having considerable fastness properties. Thick and viscous cellulose materials are particularly suitable for use with the Aerograph Lymnato spray gun. This is a special form of gun which does not atomize the solution like an ordinary gun, but draws it out into fine filaments or threads of irregular pattern, and by simply adjusting the air pressure an almost infinite variety of beautiful effects may be produced. Marbling effects may be obtained without pleating or puckering, and the Lymnato gun has been widely adopted for the decoration of ladies' hats, slippers, handbags, etc. It is indispensable that the material used with the Lymnato gun should be very thick and viscous. Beautiful results have been obtained in discharge printing with the Lymnato gun, the necessary viscosity being obtained by increasing the amount of alkaline gum in the Formosul mixture. Users of spraying equipment

(Continued on page 377)

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The American Association of Textile Chemists and Colorists

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CALENDAR OF COMING EVENTS

Outing, Northern New England Section, June 10.

* * *

Outing Mid-West Section in June.

* * *

Meeting, Piedmont Section, July 16.

* * *

SPRING MEETING, SOUTHEASTERN SECTION

THERE follows a report of the Spring meeting of the Southeastern Section of American Association of Textile Chemists and Colorists, held at the Smith Dining Hall of the Alabama Polytechnic Institute, Auburn, Alabama, April 30th.

Chairman E. A. Feimster called the meeting to order.

Discussion was held regarding the holding of a Summer meeting. This was voted down. Invitations were extended by Chairman Crist of the Piedmont Section and visiting members from Tennessee, to all members of the Southeastern Section to attend the Summer meetings of the Piedmont Section at Charlotte, and the South-Central Section at Signal Mountain, Chattanooga, Tennessee.

A nominating committee composed of Messrs. Tom Taylor, W. F. Christman, and M. T. Johnson, was selected to prepare a list of officers to be voted upon at the Fall meeting which will be held in Atlanta at Georgia Tech on October 15th.

The following were asked to act as the entertainment committee for the Fall meeting:

C. A. Jones, Georgia Tech, Atlanta, Ga.

Julian Chase, 140 Peachtree Street, National Aniline and Chemical Company, Atlanta, Ga.

W. R. Barker, 1017 Columbia Ave., Atlanta, Ga.

E. M. G. Schroeder, Georgian Terrace Hotel, General Dyestuff Corporation, Atlanta, Ga.

Paul Bolen, American Lecithin Corporation, Atlanta, Ga.

J. M. Keith, Rhodes-Haverty Bldg., c/o Houghton & Co., Atlanta, Ga.

Professor C. R. Hixon, Head of the Mechanical Engineering Department of Alabama Polytechnic Institute was introduced and gave the crowd his famous "Bag of

Tricks" bringing shades of Houdini before them with his various tricks.

Dean Zebulon Judd, Alabama Polytechnic Institute, gave a forceful and hearty address of welcome to the A.A.T.C.C. members and guests present. His address brought up the point that a great industry like textiles required technically trained men and he was happy to see the establishment of a School of Textile Engineering at Alabama Polytechnic Institute to assist in the training of the future technical personnel for the textile and affiliated industries.

A vote of thanks was extended the speakers and the Alabama Polytechnic Institute for entertainment given the members.

There were about fifty members and guests present and they inspected the new School of Textile Engineering and were high in their praise of the modern equipment and co-operative spirit shown by A.P.I. and Georgia Tech in helping this section to celebrate their first anniversary as the Southeastern Section of A.A.T.C.C. by this splendid meeting.

Respectfully submitted,

CHARLES B. ORDWAY,
Secretary.

The Preparation and Dyeing of Package Yarns*

***By* FRANK KIMBLE, JR.**

Dyer and Chemist, Mandeville, Mills, Carrollton, Ga.

IN DYEING all classes of dyestuffs on packages, it is very necessary that the winding of the yarn on the package be very closely inspected. This is of primary importance to insure uniform tension throughout the lot of packages that will be dyed together in the same machine at the same time. If some of the packages are wound hard, while others are wound soft, and are dyed together in the same machine, each individual package may be dyed uniformly, but when they are wound together after dyeing there might be a variation in the shade that will require rewinding, and redyeing of the yarn.

On mercerized yarn, and all single yarn to be dyed on the Franklin Spring, I prefer an open wind to obtain better circulation and penetration of the dyebath on the yarn. On hard twisted ply yarns I prefer a closed wind for the best results.

Extensive boiling out of the yarn in the dye machine prior to dyeing is no longer necessary for the majority of the dyestuffs for cotton. There are numerous wetting out agents on the market that accomplish the desired results at no higher cost than the older method of boiling out with soda ash and sulphonated castor oil.

When yarn on the package is boiled out, even with plain water, then cooled down to a low temperature for the dyeing operation, there is a certain amount of contraction of the package that might tend to cause channeling of the dye liquor through the package. This could be a source of poor dyeing on the package, especially if it is necessary to use dyestuffs in combination that do not have the same rate of exhaustion, or dyestuffs that exhaust rapidly.

I prefer to wet out the yarn at a low temperature, about 120° F., for the required length of time with a suitable agent prepared for wetting out at low temperatures, and then dye in this same bath raising or lowering the temperature to meet the temperature requirements of the dyestuff being used.

For best results on the package dye machine, my idea is to dissolve all dyestuffs in a stock bath before adding to the machine.

Direct and developed colors are simply dissolved in the proper amount of boiling water before adding to the machine.

Sulphur colors, with a few exceptions, require thorough boiling in a solution of sodium sulphide and soda ash to obtain the proper solution of the dyestuff. And, in practically every instance, they should be strained through very finely woven cloth or wire into the machine to prevent filtration onto the package of any precipitate that might be present in the stock bath.

Vat colors are made into a thin smooth paste with any

*Presented at Spring Meeting, Southeastern Section, April 30, 1932.

suitable dispersing agent, such as methyl alcohol or soluble oil, and water. The necessary amount of water and caustic soda are brought to the temperature of reduction, and the dyestuff paste is now added. Then the hydrosulphite is slowly added with constant stirring, after which the solution is allowed to stand with only an occasional stirring until reduction is complete, usually about fifteen minutes.

With vat dyestuffs, the wetting out bath is usually "sprung" with a small quantity of caustic soda and hydrosulphite for a few minutes before the concentrated stock bath is added to the machine. This is done to prevent any precipitation of the dyestuff that might result from premature oxidation.

The actual dyeing time for all classes of the colors is usually about one hour. With direct and sulphur colors an addition of salt, the amount depending on the depth of shade, is made after thirty minutes, and the dyeing is continued for thirty minutes longer. Some of the vat dyestuffs require a small amount of salt to effect sufficient exhaustion of the dyebath, and in such a case it may be done in the same manner.

After dyeing, the machine is drained, and in the case of direct colors, only a short cold rinse is necessary.

With developed colors, the yarn is given a cold wash, then diazotized with sodium nitrate and hydrochloric or sulphuric acid for about twenty minutes. Then a short wash, and the yarn is given the developing bath made up with the desired developer. This operation requires about twenty minutes, after which the yarn is given a thorough boiling with soap.

In the case of sulphur colors, they are usually washed cold, and in some instances oxidized with sodium perborate then soaped at the boil for the best results. Vat colors are given a cold wash, then oxidized, usually with sodium perborate, and then given a thorough boiling with soap.

Discussion

The Chairman appointed M. T. Johnson to lead the discussion.

Question: Does the use of excessive amounts of hydrosulphite require special scouring operations?

Speaker: Yes, there should be a special scouring formula prepared.

E. A. Feimster: Would you cut down the boiling out to the least time possible on all shades and dyestuffs?

Speaker: Wherever possible, I would recommend eliminating the boiling out process.

Chairman: The next speaker on the program is Mr. Robert Gow, Jr., on "The Finishing of Cotton Piece Goods."

Finishing of Cotton Piece Goods*

By ROBERT GOW, JR.

H. A. Metz & Co., St. Louis and New York

THE finishing of cotton piece goods is in no way a small field, covering the finest of cotton voiles and dress goods to heavy suitings, drills, twills, shoelinings and many other types.

From a mechanical and chemical standpoint there is little variation with the exception of application. The finisher today knows the important part both play in his daily routine of work. Almost every plant will have its own particular line of work with which the finisher is most familiar. If one were to spend a day with any particular finisher he would find how important it is to know the little kinks regarding the various machines. For instance, one machine will work well on heavy fabrics, another on lighter ones and so on. Someone may hand me a well filled sample of cambric together with the size formula, but unless I were familiar with the backfiller or Tommy-Dodd, such as settings of blades and other important features, I would not produce the same finish. Finishing then, does not mean boiling up your starch mix and throwing it into a box, but your machine must be right.

There is little variation in textile machinery in finishing plants with the exception of some little additions or developments made in the developing of new or better finishes. Sometimes this is acquired from the chemical end.

The upkeep of the mechanical side of the finishing department is very important and requires much attention in order to keep machines going and prevent damaging of cloth.

*Presented at Spring Meeting, Southeastern Section, April 30, 1932.

Briefly may I name some of the various machines used in an ordinary bleachery:

1. Roller mangle. Single and in combinations.
2. Tommy-Dodd. Single and in combinations.
3. Drying cans. Single and in combinations.
4. Tenter frames. Single and in combinations.
5. Shrinking machine.

These you find in starching departments.

Regarding finishes there are several classifications:

1. Fine voiles, lawns, nainsooks, percales, etc. These finishes will vary somewhat in their processes and chemicals used, but are classed under pure finishes.

2. Heavy pure finishes, such as used in clothing and shoe trade. These finishes likewise vary in make-up of formulas or chemicals.

3. Filled finishes. These are finished or filled on the Tommy-Dodd and in most instances fillers are added.

4. Heavy filled finishes which require two or more operation to get the finish desired.

From these observations we can readily see the importance of the mechanical end.

From the chemical end we will find the finisher attributing the same importance to the chemicals he uses and to cloth being sent to him for finishing. First may I state that uniformity of the cloth is very important, especially to the application of starches and dyes, so that good finishing starts back in the bleachery departments. The cloth should be in such a state that there will be no difficulty in getting good whites and uniform finishes. Then after this there must be a careful selection of chemicals. Briefly may I name some used in this department and group them as follows:

1. Binders and Stiffeners.
   Corn starch, potato starch, tapioca, dextrines, various gums, tragacanth, tragasol and glue.
2. Fillers and Weighters.
   China clay, talc, lime, borium sulphate, calcium sulphate, glucose, etc.
3. Ingredients used to soften and give cloth full hand and mellowness.
   Sulphonated tallow, stearic acid softeners, soluble waxes (containing Japan and paraffine wax), sulphonated castor oils (olive and mineral oil combination), and other special products.
4. Deliquescent Substances.
   Magnesium chloride, epsom salts, calcium chloride and glucose (when used because of its hygroscopic or moisture attracting properties).

From this point we find the chemist of value in making various tests as to uniformity and purity of products used, and it is of the utmost importance to the finisher to select a reliable source of supply. Next in line is the control of formulae to assure uniform finishes and that nothing is added which will have a tendency to develop defects, after the cloth has left the plant, such as turning yellow of whites, developing rancidity, odor or tendering.

Next we find the finisher must constantly develop new finishes or formulae aside from having to match other finishes produced by competitors elsewhere. He is also required to keep within reasonable cost in order to meet competing prices.

After the cloth passes through the starching department it is ready for final finish in the calendering department. Here we find that various finishes require different methods of handling as in other departments. For instance, some may require only a three bowl calender, some chase finishing, some friction and some Schreiner. Most all finishes require conditioning on the sprinkler and here too it may be stated how important it is to know the right amount of water to apply in order to give the right handle and sheen to the cloth.

The mechanical knowledge again applies itself on cloth as well as a knowledge of finishing. In some plants these two units are supervised by one man whereas in other plants you may find this a separate department, depending on the size of the plant. After leaving this department the cloth is ready for inspection, folding and packing.

Throughout the entire finishing plant we find that the two outstanding applications are mechanical and chemical, and without a thorough practical knowledge we would be at a loss to accomplish anything.

It is truly said that finishing is an art and is only acquired through long practical experience.

DISCUSSION

The Chairman asked Mr. Jesse Whitworth to lead in discussion.

Jesse Whitworth—This paper of Mr. Gow's is very helpful and should prove of great assistance to younger men in this particularly field.

M. Mackenzie: How do you make your various waxes soluble?

Answer: Japan wax and stearic acid in combination with sulphonated oils will prove a soluble form. Heavy starch mixes will hold up a prepared Japan wax mixture without settling out and a careful study of starches necessary to carry this "load" is required.

Robert Cowan: Japan wax is not a beeswax. The first is of vegetable origin and the latter an animal wax but they have fairly similar working properties. Both waxes can be completely saponified through pressure and closed vessels may be required.

Speaker: All waxes, chemicals, talcs, chalks, and fillings must be carefully checked by the chemist to insure the highest quality of work.

Chairman: The next speaker will be John L. Crist on "The Aftertreating of Sulphur Dyer Yarns and Fabrics."

Proceedings of the American Association of Textile Chemists and Colorists

The Aftertreating of Sulphur Dyed Yarns and Fabrics*

By JOHN L. CRIST

Southern Manager, Calco Chemical Co., Charlotte, N. C.

IN THIS paper, the subject of which is "The Aftertreating of Sulphur Dyed Yarns and Fabrics," we will confine ourselves entirely to this phase of the dyeing process. We will assume for the purpose of this discussion that the dyeing operation with the sulphur dyestuff has been properly conducted and the dyed cotton yarn or cloth has been properly washed and made ready for the aftertreatment. The subject of dyeing with sulphur colors is so broad in its scope that it would be impossible to cover the subject adequately in a paper of this length. Consequently, we have selected for the purpose of this discussion only the subject of aftertreatment.

There are ordinarily three somewhat related, yet nevertheless distinct, purposes that are sought after in aftertreatment. These are, for the purpose of convenience, enumerated as follows:

A. Aftertreatment to Develop the Shade.
B. Aftertreatment to Improve Fastness.
C. Aftertreatment to Prevent Tendering.

Aftertreatment to Develop the Shade

This is of necessity principally a process of oxidation since, as we all know, the dyestuff is attached to the fiber in the reduced state, and is subsequently oxidized either by blowing warm air through the fibers or by means of chemical action. This oxidation from the reduced state is one which progresses naturally and may require days, months, or even years to reach completion unless hastened by chemical means. To speed up this oxidation and to reach the ultimate point of shade development is the reason for an aftertreatment by chemical means. This is ordinarily accomplished by the use of sodium perborate, hydrogen peroxide or sodium bichromate together with acetic acid. Possibly the most commonly used oxidizing agent at present is sodium perborate. Assuming that the sulphur dyeing has been washed reasonably free from sodium, then ¾% to 1% of sodium perborate, or the equivalent of this quantity of hydrogen peroxide together with ½% soda ash is ordinarily sufficient to completely oxidize the shade. This oxidation is carried out at about 120° F. for 10 to 15 minutes, after which the goods are given one rinse, extracted and dried. Sodium bichromate and acetic acid are sometimes used to accomplish this chemical oxidation. However, the treatments with perborate, peroxide, etc., have proven to be more easily controlled and more fool proof and in the case of raw cotton are distinctly more advantageous since the development with bichromate and acetic acid leaves the raw cotton in a state that renders it very difficult to card and spin.

The chemical change which takes place in this oxidation process is somewhat obscure. This is owing to the well known fact that most sulphur dyestuffs are composed of various related chemical compounds, the composition and portions of which have not been determined. It is quite certain, however, that in this oxidation process the dyestuff molecules themselves undergo some change since we know in some instances the fastness properties are altered by the after-oxidation. This is particularly true in some of the Sulphur Yellows and Sulphur Greens.

If this artificial oxidation is properly carried out there is no further natural oxidation which takes place and the dyer can rest assured that the final shade produced in his dyehouse will not be further changed by the natural process of oxidation. This is quite naturally a distinct advantage in matching shades that have been dyed for some period of time.

Aftertreatment to Improve Fastness

This aftertreatment is normally carried out on yarn and piece goods since this aftertreatment leaves raw cotton in a state that it is very difficult to card and spin and for this reason is not applicable to cotton in the unspun state. The commonly accepted aftertreatment for this purpose is sodium bichromate and acetic acid or copper sulphate and acetic acid in one solution. The aftertreatment with sodium bichromate is intended not only to develop the shade through oxidation but also to improve the fastness to washing. The aftertreatment with copper sulphate is intended to improve the fastness to light. The reason for the improvement of fastness properties to both washing and light by this aftertreatment is somewhat obscure. I believe it is the consensus of opinion however, of those who have made a study of this subject that the improvement in fastness properties is due to the formation on or in the fibers of chromium and copper lakes with the molecule of the sulphur dyestuff. This is certainly a chemical reaction between the chromium and the copper salts and the sulphur dyestuff. Generally speaking, the sulphur color, the shade of which is changed to the greatest extent upon aftertreatment with copper,

*Presented at Spring Meeting, Southeastern Section, April 30, 1932.

chrome and acetic acid, will be found to be the color which is improved in its fastness properties to the greatest extent and vice-versa.

The concentration of the aftertreating solution is varied in different plants to accomplish the improvement desired and to conform to the individual requirements of each set of conditions. The following table will indicate the proper concentration and temperatures of solution to effect either mild or severe aftertreatment by passing the goods through these solutions at the indicated temperature:

	Mild (100 gals.)	*Severe* (100 gals.)
Sodium bichromate	5 lbs.	20 lbs.
Copper sulphate	5 lbs.	25 lbs.
80% acetic acid.....	5 lbs.	20 lbs.
Temperature .....120° F.		160° F.

Before the dyed goods are entered into this solution they should be thoroughly washed to remove most of the sodium sulphide, otherwise the aftertreating bath will be contaminated by the precipitation of copper sulphide. After the goods are passed through this solution they should be thoroughly squeezed and washed before drying.

The fastness properties of many sulphur dyestuffs are greatly improved by this aftertreating procedure. For this purpose it is rarely necessary to aftertreat Sulphur Blue and Sulphur Black dyeings as the self shades usually possess sufficient fastness. Some Sulphur Greens and Bordeauxs change shades so greatly on aftertreatment that it is not advisable, as slight changes of temperature and concentration of the aftertreating bath will result in uneven results. After sulphur dyed fabrics are properly aftertreated as above there is no further shade change on oxidation or natural development, on storing or wearing.

Aftertreating to Prevent Tendering

It has long been known that goods dyed with sulphur colors are liable sooner or later to lose considerable tensile strength. This may occur during any of the various processes immediately following the dyeing operation or the tendering may develop gradually in storage after the goods have been finished for several months. The cause of tendering has received much thought and study and it is generally accepted to be due chiefly to the formation of sulphurous and sulphuric acid, caused by the oxidation principally of the sulphur compounds in the color molecules or in less degree to the oxidation of sodium sulphide or sulphurous acid left in the goods after dyeing. The methods commonly recommended for overcoming the tendering action resulting from this oxidation depend either upon the use of oxidizing agents or upon an aftertreatment with salts capable of neutralizing free mineral acid, or upon an aftertreatment with substances that will prevent subsequent oxidation.

The product most commonly used for oxidation is sodium perborate together with soda ash. The normal procedure is, after the cotton has been dyed and thoroughly washed, to aftertreat with approximately 1% sodium perborate and ½% soda ash, starting the bath cool and gradually increasing the temperature up to 160° F. The goods are then immediately extracted and dried with or without rinsing. This process not only oxidizes to completion the sulphur and the partially reduced sulphur compounds in the dyestuff molecule in the harmless alkaline state but it leaves the goods slightly alkaline as an additional safeguard against the development of sulphuric acid. This process is very simple and one which the speaker has never known to fail. If the sulphur and sulphur compounds are completely oxidized to alkali sulphate, there is no possibility of subsequent formation of sulphuric acid.

A second process sometimes used depends upon impregnating the goods with an insoluble calcium salt which reacts with the ultimate sulphuric acid as it is gradually produced and in that way provides a permanent method of preventing the tendering of dyed goods. The process consists in treating the dyed goods either with a very finely divided insoluble calcium salt, such as carbonate, or with a very weak solution of tannic acid and subsequently with a solution of lime water, washing and drying. This process is only to be used on material to be given a hard and stiff finish.

An additional method of aftertreatment to prevent tendering consists of the use of glucose in the finish. This glucose, being a reducing substance, prevents subsequent oxidation of the sulphur compounds to sulphuric acid.

A correction method that has formerly been rather widely used consists in aftertreating with a sodium acetate. The theory back of this practice is that sodium acetate, being an alkaline salt, would be decomposed by sulphuric acid formed and result in the formation of harmless sodium sulphate and acetic acid.

It is noted that the aftertreatment for developing the shade with sodium perborate and soda ash is identical with the aftertreatment with these two compounds to prevent tendering. Where it has been determined there is no serious loss of wash fastness by this procedure, it is a very desirable step and one which will be more widely used once its merits are fully realized, since in one process the shade is developed and tendering prevented or the hazard greatly reduced.

Discussion

Chairman appointed Mr. Edgar White to lead discussion.

Question: Do you feel that in these oxidation processes each dye in the compound shades will have an individual degree of oxidation as to time element?

Speaker: For all shades that have two or more dyes, each dye changes individually on oxidation so that the

process of oxidation must be complete to insure a match at a later date.

E. A. Feimster: Does the use of glucose prevent tendering of sulphur blacks?

Speaker: The theory back of the use of glucose is that it is a mild reducing agent and prevents formation of sulphuric acid on fabric and allows a complete oxidation of sulphur black. A hot soap bath will not take the place of glucose as the source of sulphuric acid must be removed. Oxidation must take place in the alkaline state.

Marvin Youngblood: What is your recommendation on Sulphur Bordeauxs?

Speaker: My recommendation is to use intensive hot washing and light acetic acid bath as Bordeauxs are very sensitive to an alkaline bath and this causes streaking on storing.

H. H. Fields: It appears from our mill observation and experiments that the use of acetic acid is always vitally important in control of sulphur shades when aftertreating.

E. A. Feimster: Our plant observation and experiments have shown that all organic or inorganic chlorides must be eliminated from sizing and finishing and then this is followed by intensive washing and use of sodium acetate which has eliminated all tendered sulphur dyed fabrics for us in the past year.

C. B. Ordway: This should eliminate calcium and zinc chlorides which have a tendering action on cotton and would readily form in a water supply that is of a hard nature if metallic chlorides are used.

Speaker: All chlorides are just so much "dynamite" on the fabrics with sulphur dyes. This is especially true of metallic chlorides.

Technical Education*

***By* E. W. SIKES**
President, Clemson College

ON FRIDAY, May 6, the Engineering students put on a pageant representing the evolution of many phases of engineering and architecture. Their enthusiasm is carrying them farther and farther back, even into an ancient period of ancient history. The impressive thing is the change from generation to generation. Transportation reveals the same change, so does costuming. The student of Education finds the same change. Finally, one is compelled to reach the conclusion that there is no such thing as finality in education, no such thing as the last word, no such thing as an educational faith delivered unto the saints once and for all.

In the Middle Ages theory was the dominant theme. The making of saints was the great desideratum. The schools, consequently, emphasized mathematics that they might be able to calculate the time of Easter and other saints' days, music that they might sing. Then came the Revival of Learning, or the Renaissance, when the rich store of Greek and Latin learning was opened up. The Theologians in England responded to this revival in England by establishing Oxford and Cambridge Universities where Latin was the chief subject of study that the pupils might know Justinian's Institutes and the Roman Law; Greek, that the philosophy of Plato and Aristotle and the New Testament way of life might be known. The emigrants to America—Puritans in the Northeast and churchmen in Virginia—brought these same ideas with them. From Harvard and William and Mary came our ideas of education. It was the classical type. Until Thomas Jefferson there was practically no other type. The institutions did their work well. Any system that could produce at one time a John Adams, a James Madison, an Alexander Hamilton, a Jonathan Edwards, a Webster and a Calhoun has done its work well. But even Jefferson in his seventy-fifth year expressed himself as not satisfied with such a restricted field. The man who wrote the Declaration of Independence, who was the author of the statute of religious freedom, who abolished primo-geniture, could not be expected to be satisfied with an educational system which fitted for law, ministry, and medicine only, a system which was aristocratic and belonged only to the learned profession, a system open to the son of the farmer and the mechanic but which took him out of his class and initiated him into another. However, Jefferson, though founder of a university, never saw his ideas triumph.

The second great revolution in this country came in 1829 when Andrew Jackson became President of the United States. He was placed there by the farmers and

*Presented at Quarterly Meeting, Piedmont Section, April 23rd, 1932.

mechanics. At the same time Methodists and Baptists began to be influential. A new type, a new democracy, a democracy that had its roots in America, not in Europe, was coming to the front. The War of 1812, in which Jackson had taken part at New Orleans, gave a great stimulus to American industry. Behold then a new educational movement started also! Stephen Van Rensselaer was a wealthy Dutchman in New York who owned 900 farms. He saw the need for better farming and founded Van Rensselaer Polytechnic Institute at Troy in 1824. Being an advocate of building the Erie Canal he saw the opportunity for the study of Geology and put that in the school. He saw the need for the civil engineer and placed Civil Engineering in the school. This was the first school for technical education in the United States. Then the denominations became dissatisfied with the state universities; they started schools based on agriculture and some engineering, which engineering equipment consisted of blacksmith shop and tools. This industrial venture failed. But industry felt the need for trained men; importations from Europe were not enough. Then the Massachusetts Institute of Technology was organized and then two others in the Northeast.

In 1854 Jonathan Turner in Illinois began to advocate a "Peoples University" saying that the farmer and the mechanic were entitled to education along his special line just as much as the lawyer, the preacher and the doctor. The farm lands of the East were becoming exhausted and the population was moving to the central West. About the same time Dr. Thomas G. Clemson returned from his scientific studies in Europe, where he had spent probably fifteen years, and began to proclaim in the press from his Washington office that the only hope for the farmer and the mechanic lay in the popularization of science, and that the millions of acres of public lands should be given to the states for this purpose. Congressman Morrill of Vermont wrote a bill to that effect. Much to the disappointment of Dr. Clemson his friend and neighbor, President Buchanan, vetoed the bill as dangerous, undemocratic, and wasteful. But in 1862 Lincoln signed the bill having told Morrill that he would. This bill was the beginning of an educational revolution in America—a revolution that has influenced the old universities, the public schools, and the industries. These institutions were established in every state and furnished a friendly atmosphere for Agriculture, Engineering and Science.

But these institutions had to be pioneers. Conditions demanded that a type of institution be founded that had no counterpart in Europe nor America. In 1859, when Buchanan vetoed the bill, Darwin published his *Origin of Species*—a book which has changed our whole method of thinking—a book which taught us to stop guessing, to throw tradition and superstition to the winds, to let authority go; on the other hand to observe, to study first hand, to make records, to ask nature to answer the questions. "Don't argue about the number of legs a grasshopper has. Go to the grass-hopper. He won't lie about it."

Science came knocking at the door of the colleges, but it was an undesirable waif left on the door-steps. The early teachers of science had been placed in basements or off the campus. The public authorities in Ohio would not permit a railroad meeting in the school house. They said they were willing to permit any reasonable kind of meeting, but that the Lord never intended for his intelligent creature to travel fifteen miles an hour. The same attitude was found towards street lights. They said "Night is intended to be dark so that people will stay at home," "The odor from gas will poison the air."

Now this new type of college welcomed Agriculture, Engineering, and Science, but it was all pioneering. Chemistry, Physics, and Botany were being developed, but not applied. At first the teachers sought the best methods of farmers, but found that even good farmers use different methods, found that different climatic conditions demanded different treatments. The result was the laboratory, or the Experiment Station. The Hatch Act was passed in 1887. These institutions are based on science, not on language, and on applied science following the pure science. The result is soil chemistry, feeding cattle, the Babcock Tester, the gasoline engine. Patents and inventions multiplied. There has been more progress in 75 years than in 750 years before. The democratization of education has followed. The neglected class is no longer neglected. Farming has become the Science of Agriculture; Mechanic Arts the Science of Engineering; Science is not only the handmaid of progress, but the Joan of Arc leading to victory over the Malthusian Law of over-population.

The professional educators were shocked when it was learned that a chemist, Eliot, had been elected President of Harvard. Then he did proceed to shock them with the enlarged field of knowledge. An elective system had to come.

No longer could a teacher depend on the textbook assignment. That system would do in teaching Homer's *Iliad*, Virgil's *Aeneid*, or Euclid's Geometry, but it would not do for soils, fertilizers, nor textiles.

Technical education has so far advanced in the South that we do not have to go beyond our borders to find men who can build our railroads, bridge the rivers, handle our textile plants, and construct our dams and buildings.

AMERICAN DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto

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OLD MACHINERY

THE problem of old machinery sold at bankruptcy prices and put into operation again in competition with mills which have comparatively recently paid full market prices for new equipment is not altogether a new one in the textile industry. It is deservedly receiving particular attention at this time, however, inasmuch as it promises to become a factor of increasing importance in the business, particularly in the full fashioned hosiery trade.

The point is emphasized by the sale recently of a lot of old 39 gauge machines, operated for years by a mill now in liquidation, at a price declared to average less than $500 per machine. It is not a secret that the price paid was higher than had been generally anticipated, as a result of competition at the sale. These particular machines, and others in their approximate class, have frequently been described as junk, but junk or no junk, they will operate and produce hosiery which will find a market at some price. It is not hard to guess at about what price.

The incident mentioned above, in connection with the sale of the hosiery machines, is just as true in the case of dyeing machinery. One thing that makes the situation a little less unpleasant is the fact that these old machines can not do as good work as up to date machinery and will be worn out much sooner. However at the present time they do offer serious competition to the person purchasing new machinery.

This may be and is considered a form of improper competition by the man who has a considerable investment in practically new machines still to be written off. Raging and foaming at the mouth will not solve the problem, however; the solution, indeed, is not easy to find, because of Federal laws with regard to restraint of trade, restriction of competition, etc. It is not impossible, however, that some legal method can be found of limiting the harm that can be done to a considerable portion of an industry by the sale, forced or otherwise, of old machinery at sacrifice prices. It is to be hoped that the possible will soon become the probable.

THE BUDGET AND EXPENSE CONTROL

ONE of the most effective ways of checking up on expenses is through the use of the budget system. This is particularly true under the departmental form of administration, where the individual expenses can be precisely allocated and carefully scrutinized. Increases are immediately noticeable and savings on the budget are also quickly discernible and attributed to the right department.

In making up a budget there are two methods in use; the one using past expenses as a model and the other using a forecasted expense account. The former is probably more widely adaptable to the average concern as the latter requires market research and forecast as well as the cost of covering the market before it can be put into application.

The chief argument in favor of the budget system is the control it affords through the comparison of actual expenses with budgetary allowance. During periods of lessened business activity control of manufacturing expense becomes of increasing importance and should be checked more thoroughly. It has been shown in various companies where budget control has been used to check on the manufacturing expenses that this system could be expanded to include all items of expense appearing on the profit and loss statement. Every item appearing on the manufacturing expense budget has a direct relationship to the volume of production. Some items are unaffected by changes in manufacturing activity whereas others are affected to a greater or lesser degree as the volume of production increases or decreases. The use of the budget shows the exact relationship of all of these several items in regard to the total manufacturing expense. Try a budget system of expense control.

MORATORIUM ON CHEAPNESS

APPEALING to retailers to do their part in helping to improve business conditions, D. I. and C. H. Stirn, Inc., expresses the opinion that a "moratorium on cheapness" would benefit the silk industry and the trades connected with it. In the latest issue of its publication, this company says, in part:

"As a general principle, every retailer—no matter what the price ranges in his store—should have at least some low or minimum point in the quality of his merchandise beyond which he refuses to go, for a standard is now necessary if business is to be preserved.

"Today, there are some cloths sold over the retail counters that have become so deteriorated in actual quality that no dress manufacturer, however cheap his models may be priced, will put them into his garments. In order

to meet retailers' demands for a given retail price, some fabrics have been cheapened so that they aren't good enough even for a low-priced dress manufacturer to use. If that is the case, how can they be good enough for the woman who goes to the piece goods counter to buy materials?

"Every silk buyer at the present time is familiar with this condition. It is part of the gossip and news of the trade—that buying has degenerated to the extent that the consumer is really being deceived.

"A buyer comes into the market with the feeling that he has got to get something to sell at 89 cents. All the way in on the train he is turning over in his mind, 'Where can I get something for 89 cents?' His whole attention is concentrated on the price. Why? Because some other store in his town is apparently doing well on some featured item at $1. So this buyer comes into the market and cajoles some wholesaler into giving him something that will answer the purpose and that can be sold at 89 cents. There is a little taken out of the material here and there, but why think of that? The markup has to be reduced somewhat but 'We'll take a chance on that.' The word goes back to the advertising department—'Get ready to feature these items with a ballyhoo at 89 cents.' Not that they're good . . . not that they show a profit . . . but to feature a price that will take business away from the other fellow."

Standardization in Dyestuff Industry

Discussing the subject of color standardization in a recent issue of *Kunstseide*, Bernard Teufer, after an examination of the practical utility of standardization and of the various bases on which it may rest, rejects "systemization" in the color industry and pleads for color charts as the practical method, these to be agreed by the various interests concerned. His arguments are summarized as follows:—

The basic requirements for fixing a standard are:—

(1) Definition of the subject to be standardized.

(2) Arrangement of the whole subject whether according to size or quality.

But, no standard can be fixed if neither quantity nor quality can be measured, as there is then no means of checking or comparison. This objection applies to dyes and their shades and hitherto there has been no satisfactory classification, though the work of Ostwald and others towards that end must be acknowledged.

The disadvantages of Ostwald's classification of the main colors is that it does not allow either for the infinite gradations of shade in the one color, or for the fact that one shade merges into another and cannot be arranged systematically. Though accepted as a fundamental standard by the German Standards Office, it has never gained universal application, nor does anyone appear to have examined the reason for its non-acceptance.

At first it was thought that a systematic arrangement that the system did not help to ease the dyer's work or of colors could be achieved, but in practice it was found lower his costs; it did not save anything in warehouse space, nor give any security that the same color would be the same if coming from different dyehouses. It did, at least, succeed in settling the names of different dyes and making pricing an easier matter.

In the search for another method we find something already extant in the form of color charts, which have been used for some time in the textile industry, but have never been unified as standards.

These, in the shape of color sample, etc., are of the greatest practical utility. They have been restricted and changed according to the ruling fashion. To instance an advantage resulting from this kind of color standardization—note its application in the reckoning of rebates on account of large quantities dyed in a standard continuous bath.

The ruling fashion is rightly the dictator which governs these color charts, and this may alter twice or thrice a year without interfering with their usefulness as a standardized base.

As fashion is the final arbiter, we should not endeavor to fix a few integral color shades as a standard for all purposes. On the contrary, a very great number of standards are required, since the effect of the color on the eye may be entirely different for different raw materials, there may even be differences in the effect in the same material. It will be found that even in such simple matters as the parallel case of color standards for pipe lines, that local requirements may necessitate a departure from standard.

Because of the extraordinary variety of demand it is idle to pursue the will-o'-the-wisp of a *systematized* color standard. It is essential to realize this error and to point the way to the true value of a rational color standard. This can only be achieved by massing the knowledge already available, thus preventing overlapping and double effort, and working out the correct standards by an extension and unification of the color chart method.—*Textile Mercury and Argus.*

Du Pont Produces New Suede Fabric

A development in suede effects, known as Doe-Tex, a light-weight, waterproof material with the dull-surfaced softness of suede, is announced by the rubber products division of E. I. du Pont de Nemours & Co. It is developed in sharkskin, buffalo, caracul and pig-grain effects, brocades, embroidered and quilted patterns, as well as the plain suede finish. It is available in a variety of the season's most popular colors including kasha, fawn, beige, cadet blue, vivid reds, green and white. Doe-Tex has been perfected for use in men's and women's sport garments, shoes, belts, hand-bags, dress accessories, novelties, bookindings and household articles.

On Comparative Tests For Wetting-Out Reagents*

By W. F. A. ERMEN, M.A.

This article discusses the best circumstances in which to use wetting agents.

RECENT chemical research has made it clear that the introduction of certain well-defined complexes into an organic molecule will give rise to bodies which, in very dilute aqueous solutions, have the power of so lowering the surface tension of the water that textile materials of all kinds are wetted through and through much more rapidly than when immersed in water alone. These bodies are known as "wetting-out agents." All the chemical manufacturers vie with one another in turning out an endless stream of these products, and the latest arrival on the field is invariably heralded as the "best ever." Many of these wetting-out agents can be induced to combine with fat solvents of one kind or another in such a way that the fat solvent, in itself insoluble in water, remains either completely dissolved on dilution of the mixture with water, or, if it does separate, it only separates in such a fine state of division that the emulsion formed is for all practical purposes permanent. Thus it comes about that the textile chemist is constantly being confronted with new wetting-out agents and scouring agents, and requires to be in a position to make some readily applied tests for the comparison between the new body and the one which he is already using, before he can decide whether the newcomer has features of sufficient merit to make worth while the carrying out of a practical works trial.

Such a test should call for the use of only the simplest apparatus, should be quick, and the results obtained should be reliable. Many tests have been proposed from time to time, but they are nearly all based on the same principle. Either a fragment of textile material is allowed to fall on to the surface of the solution to be tested, and the time noted that is taken by the bit of material to become saturated, or to sink below the surface of the liquor. Other workers in this field weight their bit of textile material so that it is drawn down at once to the bottom of the vessel, and note the time taken for the fragment to lose the entangled air which at first gives it buoyancy. The textile material most commonly employed for these tests is cotton. Cotton, however, does not appear to be altogether an ideal material in this connection. Raw cotton, applied to a solution of low-wetting power, is so water-repellant that it may remain floating for an inconveniently long time. Small squares of cotton cloth in the grey state exhibit this tendency to an even greater degree, and have the further disadvantage of being inclined to curl up as the moisture begins to penetrate. In the folds thus formed bubbles of air are liable to be trapped, and we then get an abnormally long time before the cloth sinks. Scoured cotton cloth, on the other hand, absorbs water so readily that the sinking time, even with plain water, is not long enough to enable us to differentiate between good, bad, and indifferent wetting agents.

After trying out various textile materials, a cheap white flannel was found by the author to give results of the kind desired. Cut into pieces about 1 cm. square these bits would float for hours on plain water, whereas with efficient wetting solutions they would sink in about 1 sec. Five representative wetting-out agents were accordingly selected, and their wetting powers compared at various dilutions in distilled water, by allowing the little squares of flannel to drop on to about 70 cc. of the solution contained in a glass cylinder, and noting the time taken for the test piece to sink below the surface of the liquor. The wetting out with this material takes place in two distinct stages. First, the flannel flattens itself out completely and lies down on the surface of the liquor, which then at once begins to penetrate until the whole surface of the cloth is wet. Then one corner of the square begins to sink below the surface, until it is completely covered with liquor. At the same time it leaves the edge of the cylinder, to which it always floats during the first stage, and the second stage is conducted right in the center of the liquor surface. As soon as the surface of the flannel is covered one corner dips down, and the whole bit begins to fall rapidly to the bottom of the cylinder. The time is taken from the moment of dropping on to the liquor to the moment of leaving the surface. The values obtained are shown in the following table:—

WETTING-OUT TIMES IN DISTILLED WATER

Concentration of Wetting Agent	0.5% Secs.	0.25% Secs.	0.125% Secs.
Sample A	2	24	293
Sample B	16	96	Over 10 mins.
Sample C	25	39	45
Sample D	57	64	150
Sample E	37	45	205

*Textile Manufacturer.

These figures illustrate clearly the great difference that exists between some of the best-known wetting agents at normal dilutions. In the case of all but one of the samples tested the wetting-out power is reduced below practical limits when the substance is used at a concentration of less than 2 lbs. per 100 gals.

Normally, wetting out is not done in distilled water. The water commonly met with in bleach crofts and dyehouses may exhibit anything up to 30° of hardness. In order to investigate the effect of using such a water, a hard water was made up by dissolving 1.1 grms. of calcium chloride in 4 liters of Manchester top-water, which of itself has about 5° of hardness. This gave a water of approximately 30° hardness, mainly permanent. Solutions were made up in this water of the same five samples, at the same dilutions as before, and the following results were obtained:—

WETTING-OUT TIMES IN WATER OF 30° OF HARDNESS

Concentration of Wetting Agent	0.5% Secs.	0.25% Secs.	0.125% Secs.
Sample A	2	4	9
Sample B	9	19	52
Sample C	42	52	68
Sample D	38	58	247
Sample E	15	17	29

It is claimed by the manufacturers of these modern wetting agents that they are not affected by hard water, and this claim is shown to be to a large extent justified. Sample A, for instance, at its maximum dilution of 1¼ lbs. per 100 gals., has lost very little of its effect, the wetting-out time being still only 9 secs., as against 293 in distilled water. Sample C, which stands out for its resistance to dilution in distilled water, again shows a comparatively small falling off in successive dilutions in hard water, although very much inferior to sample A, whereas sample D is less successful in hard water than in distilled. On the whole, wetting out is seen to be much more easily effected in hard water than in pure distilled water.

Wetting out in a dyehouse is frequently accompanied by a scouring action, and this scouring action is effected by the addition of an alkali. The next table shows the effect of making the wetting-out tests in a caustic-soda solution of 2½° Tw., made with tap-water.

WETTING-OUT TIMES IN CAUSTIC-SODA SOLUTION OF 2½° TW.

Concentration of Wetting Agent	0.5% Secs.	0.25% Secs.	0.125% Secs.
Sample A	5	5	5
Sample B	15	17	38
Sample C	60	136	388
Sample D	38	50	60
Sample E	26	53	137

At the highest degree of concentration one sees that caustic soda does not materially effect wetting-out powers. There is a slight falling off in all except sample E. At 2½ lbs. per 100 gals. the wetting-out effect falls off seriously, except in the case of sample A, which is still maintained at the lowest dilution, where the other four samples show a still further drop. Caustic soda then definitely injures, in most cases, the efficiency of a wetting agent.

In wool scouring and dyeing caustic-soda solutions are not used, but in the dyeing and wool dilute solutions of sulphuric acid play a considerable part. A 2° Tw. solution of sulphuric acid in tap-water shows the following remarkable results:—

WETTING-OUT TIMES IN 2° TW. SULPHURIC ACID

Concentration of Wetting Agent	0.5% Secs.	0.25% Secs.	0.125% Secs.	0.0625 Secs.
Sample A	1	3	6	20
Sample B	3	6	17	57
Sample C	23	23	30	59
Sample D	11	15	25	46
Sample E	13	19	30	40

In every case wetting out is thus shown to be more rapid in a dilute acid solution than in pure calcareous or alkaline water. It would thus appear that to effect a thorough wetting out in the most economical manner this should always be carried out in a weakly acid medium, instead of in the presence of an alkali, as is usually done. Traces of acid are easily washed out of any fabric in which it can be deleterious, and when wetting out has been thorough, as in this case, it should offer no obstacle to further operations carried out in alkaline liquors or hard waters. It should be noted that all these tests were carried out at the ordinary room temperature, at about 15° C. Tests made with solutions cooled to 12° C., or warmed to 18° C., showed very little difference. It is not till a temperature of 35° C. is reached that wetting-out times begin to fall considerably. The following table shows results obtained with a dilute solution of sample C in 2° Tw. sulphuric acid:—

WETTING-OUT TIMES AT VARYING TEMPERATURES IN 2° TW. SULPHURIC ACID

Temperature ° C.	Wetting-out Time Secs.
20	137
26	96
37	33
49	10
62	5

Whether all wetting-out agents shows similarly beneficial results when used at higher temperatures has not yet been determined, although such an effect seems probable. It also remains to be seen whether the same result will be obtained with alkaline or hard waters.

A Science Audit of the Textile Industry*

By **MAURICE HOLLAND**

Director, Division of Engineering and Industrial Research, National Research Council.

THE story is told that Louis Agassiz, the father of marine biology, from a single fish scale, was able to identify the species, locate its habitat, determine the age and size of the fish from which it came. He traced the path of progress in history of living beings, of past ages to those of the present time. From the point of view of a science audit of an industry, the outline of his work was a master pattern, and so in this science audit of the textile industry I will attempt a thumb nail sketch of the industry, its present research position, and its future possibilities, if the levers of applied science are used in putting the science foundation in place for a future cathedral of modern industry.

What living scientist can take a single fibre from a cotton fabric and tell us one-tenth of what Agassiz could, from the single fish scale? Could he tell in what country or state the cotton was grown; could he trace its evolution from a single fibre to the finished fabric through the various manufacturing processes? What scientific sleuths cast a stony eye on the atomic building blocks that go into your product, and the research mind which is as inquisitive as an X-ray follows every step of the process, a foundation anchored in the bed rock of pure science will then sustain a cathedral of modern industry.

In the Kaiser Wilhelm textile research laboratories near Berlin I have seen scientists cutting through the section of a single cotton fibre and making an X-ray analysis of dye penetration, mercerization processes, and other manufacturing operations which affect the single component element of cotton fabrics. I was shown metallized fabrics. Metal threads were being made of single crystal wires from a dozen metals. In short, I saw German patience, thoroughness, and skill in scientific apparatus and technique being applied to one of the oldest industries known to man.

The textile industry in America, as I see it, is a 1932 model car running around on a gay '90 chassis. The essential manufacturing processes have not been changed in one hundred years, and the last page in textile invention was written in that era of vanishing American genius when Northrop's loom was developed in the late '90's. Only a boiler factory rivals a textile mill in developing fatigue factors to distress the over-worked operators.

Raw materials travel miles and wear themselves out passing from one machine to another.

It is a miracle to me that anything comes out of them but chaff and dust. The poor cotton fibres must be completely exhausted. If they could tell a story of the fatigue phenomena through which they have passed on the long road from the cotton bale to the finished fabric, it would make some of the present day calamity-howlers sit up and take notice. *De*pression and *com*pression, is an every day occurrence in the family of fibres. Family life is a series of tearing apart, putting together, until it must be an obsession!

Who said that in order to make a cotton fabric you had to put these individual fibres through all these processes—carding, drawing, roving, winding and weaving? Perhaps around the corner in some scientific ice-box there is a process similar to that used in synthetic plastic components which will convert the cotton fibres directly into fabrics that will be superior to those now turned out. All that is needed is the thawing influence, of a place in the "sun of applied science."

There is fundamental research work going on in fields of science not far remote from the textile industry, yet with applications which may eliminate the "riveting hammer" noise of loom and shuttle, speed up production, and turn out a better quality fabric. There are a dozen types of textile fabrics which could be made from cotton to better serve a dozen new uses of man.

A few illustrations of new fabrics which occur to me at once are cotton fabrics which afford more uniform temperature regulation for the human body, a health measure, fabrics which absorb perspiration and prevent summer colds, others which afford some measure of insulation against cold winds. Still other fabrics which offer softer texture next to the skin and those which can take advantage of cotton's natural advantages as style factors. In the industrial field there is need for metallized and fireproof fabrics—at a price, while waterproof fabrics are a myth in America.

Within a month, I have been told by the Curator of Paintings of the Metropolitan Museum of Art, that it is practically impossible to get a modern canvas for oil paintings which compares with those manufactured in

*An address presented before the United States Institute for Textile Research, Inc., Wednesday, May 4, 1932, at Hotel Biltmore, New York City, at luncheon-reception in honor of Hon. Francis P. Garvan, president of U. S. Institute.

the sixteenth or seventeenth centuries. There is a challenge to your industry. That is the kind of job that science tackles with success.

As long as the natural conditions, the old order of competition, continues, there appears to be no cause for concern, for was it not the moisture of New England air, with its natural humidity, that fixed the center of the textile industry?

As long as nature withholds her secrets from man, the old order prevails. Then along comes science and wrests another secret from nature and the center of industries—yes, of worlds—is changed. A single discovery from the laboratory may mean a new competitive industry, or expansion for one and losses for another.

For a long time it was the climate that prevented us from locating textile mills in the South, in the area of raw materials. Engineers and chemists then tackled the problem of manufacturing suitable weather "indoors" with mechanical aids, and nature's deficiencies were supplied by science. Recently the enterprising Chamber of Commerce of Los Angeles made a bid for the fine cotton goods industry of the East, and these "home industry" boosters promised a local supply of raw material in the form of "native" long staple cotton grown in the Imperial Valley.

Out of a test tube of chemicals science created the rayon industry, and another triumph of research produced weather "on order." Rayon factories are now erected in the region of cheap power—Buffalo, for instance. With the advantage of economic power, plants are located in favorable labor markets and strategically placed to take advantage of raw materials produced locally. With production costs reduced by research the rayon industry is today selling half hose on the counters of the Five-and-Ten Cent Stores at ten cents "a half," and attractive stockings have been placed within reach of more millions of women, once customers of the cotton industry.

Long-haired "Ph. D's," peering out through thick spectacles, looking into the micro-world of textile fibres through the barrels of microscopes, were the flying wedge of the science army that invaded Lancashire, the traditional center of the textile industry in England. The practical executives then running the business, on technology handed down from father to son, only scoffed at the men who had never seen the inside of a textile mill. Today the Cotton Research Association is one of the strongest in England. A completely organized research unit operated and supported by 95% of the producing industry. Their work begins with the botany of the cotton plant and carries on through every stage to the finished product, which is made in a semi-works scale factory, under laboratory supervision. When I visited the Association laboratories last summer, the Director told me that the laboratory staff, the research facilities, and the annual appropriation was more than double those on the previous visit in 1926. There is no depression in research activities in England, even today!

A "depression survey" now being made by our Division (the results of which I am not yet at liberty to announce) indicates that the "research industry" is booming. In the aggregate more money is being spent on research than last year. Authentic figures indicate that a larger percentage of sales income is spent on research. A number of industries are virtually living today on products which have been developed by their research laboratories in the *last two years!*

In these days of "compression" that is a significant statement. I say compression advisedly for "a lot of water is being squeezed out of the whole fabric of industry." It is true that the whole fabric is somewhat shrunken in dimensions but there is a concentration of strong component parts of the "tear" strength of the industrial fabric has been increased. Industry has been hung out to dry in the "sun of science." The competition of science-minded industries will do the rest.

Forecasting futures by a study of the present trends of research in industries will be reduced by trained observers to be the same simple formulas and computations which now govern transactions in May cotton, in December wheat, on the exchanges.

In the not far-distant date of the science audit of an industrial company, barometer charts based on the technical—not the commercial—side of the industry will appear. The technical audit as a supplementary safeguard to protective devices now used in long-term industrial loans seems to be an inevitable development in banking.

Behind the balance sheet are factors which play an important role; such factors as the technical state of the art, plant processes and product, research facilities, the attitude of the management towards research, technical advances in foreign countries which may influence the domestic market—all have a meaning to the eye of the skilled observer which may be translated into the language of dollars and cents—deficits or dividends.

When the balance sheet is cast up for the textile industry, one conspicuous item is "fixed assets." That word "fixed" is the fly in the "industrial ointment." Nothing is fixed these days! Recently many industries have slipped from their moorings, in the swift running tide of industrial competition, unless they are anchored in the bed rock of pure science. Applied science is the motive power of industrial change. The tempo of our industrial life is a dynamic crescendo. Is the textile industry on the move? Is it keeping up with the Big Parade of modern, science-aided industries?

Research is listed as an association activity of at least seventy industries spending approximately fifteen million dollars annually. How much is the textile industry spending on research?

Few of the large fortunes which have been made in the fields of the textile industry have been plowed back into the soil of science. In the garden of science the fruits come to full bloom and the seeds of service are sown for future generations. My picture of research in the textile industry is a motion picture—gone modern.

It has all the drama, romance, and even mystery of most feature pictures but from where I stand it appears to me—to be a talkie! It is impressive with sound effects, but there is little or no action! I'm speaking now of fundamental cooperative research in the interest of the whole industry. An examination of our Division records shows that our efforts in promotion of research in the textile industry began over ten years ago and we have been hammering away at it ever since. The last item in our records of persistence is being written as I speak to you today! We continue to offer the industry the resources and facilities of our Division, of the whole Research Council, when, as, and if we can be of service.

A few large companies in the industry have excellent private research laboratories. Most of these, however, appear to be development work, testing, and "trouble shooting" departments; going "high-brow" with the much abused name—"research." My guess is that the fundamental scientific discoveries, which will revolutionize the textile industry, will come out of the university laboratories. Research dollars are the premium on a policy of "industrial life." The industry may yet pay tribute, in the present war of industrial competition.

The industry which, neither as an individual, nor as a class group, concerns itself with industrial research may, like the ships which crossed the Atlantic during the Great War pursue its course without mishap. But that course is perilous. All over the world, there are research men at work, and their findings today may, in the light of subsequent events, mean the beginning of the end of someone's long established business. That has been the history of industry, and that must continue to be the history of industry.

It has been demonstrated repeatedly in the history of American industries that research is a paying investment. Ask your banker. He knows!

Effectiveness of Silicon in Weighting and Bleaching

(Continued from page 360)

motor truck, and dairy refrigeration are still other uses of this interesting silica.

In refininig cracked gasolene, this substance is used to remove gum forming substances and also to remove sulphur.

Solvent recovery in the manufacture of rubber, rayon, leather, etc., are still further uses for this adsorbing agent.

It also has medical uses, and is being exploited for toilet powder and tooth paste.

Spray Dyeing

(Continued from page 362)

should take fully into their confidence the makers of the equipment, in regard to the solutions to be applied and the class of work to be done. It is only such cooperation that ensures the correct kind of gun, fitted with the right size of nozzle, and such details make or mar the whole result.

Graduating Exercises

North Carolina State College

The annual commencement exercises at North Carolina State College began on June 5, when Rev. Dr. A. D. P. Gilmour, pastor of the First Presbyterian Church at Wilmington, N. C., preached the baccalaureate sermon.

Monday, June 6 was given over to the alumni and was featured by the annual address of Dr. E. C. Brooks, President of State College, which was delivered at the close of the alumni luncheon. S. B. Alexander, southern manager of Crompton & Knowles Loom Works, who is president of the general alumni association, presided at its annual meeting which was held Monday afternoon. Many prominent textile manufacturers attended class reunions during the day.

Monday night, following the oratorical contest, the medal awarded annually by the National Association of Cotton Manufacturers to the most proficient textile student in the graduating class, was presented to Newell R. Whitener of Gastonia, North Carolina.

Tuesday morning, following the commencement address by Merle Thorpe, editor of *The Nation's Business*, diplomas will be presented to the graduating class.

The following degrees will be awarded to students taking the courses indicated in the Textile School: Bachelor of Science in Textile Manufacturing, Bachelor of Science in Textile Chemistry and Dyeing, Bachelor of Science in Yarn Manufacturing and Master of Science in Textiles.

Lowell Textile Institute

Commencement was held at the Lowell Textile Institute on June 5th, 6th, and 7th. The baccalaureate service was held at the Calvary Baptist Church on Sunday, June 5th, Rev. Alexander Henderson delivering the address. On Monday a class dinner was held in Southwick Hall followed by the dedication of the class section of the Alumni Fence surrounding the campus. The graduation exercises will be held in Southwick Hall on Tuesday. The speaker will be Prof. George B. Haven of the Massachusetts Institute of Technology. The Commencement Procession will be under the direction of Faculty Marshall, Prof. Ai Edwin Wells. Bachelor of Textile Chemistry and Bachelor of Textile Engineering Degrees will be awarded in those courses. Diplomas will be awarded in Cotton Manufacturing, Wool Manufacturing and Design.

King Elected Durene Chief

R. B. King, secretary of the Hampton Co., Easthampton, Mass., was elected president of the Durene Association of America at a general meeting of the Association membership in New York City on Thursday, May 12th.

Members agreed that, instead of an originally anticipated five year period of preliminary activities, it has taken approximately two and one-half years for its quality maintenance program to gain the interested attention and active cooperation of the industry's immediate customers, and distributors, and vendors.

NEW PATENTS

(*Abstracted by Synthetic Organic Chem. Mfrs. Assn.*)

Color Matter and Process of Making Same. (Dyes animal and vegetable fibres from a reddish-brown vat bright green tints of very good fastness. The process, for example, consists in heating 1-hydroxy-naphthalene-3.4-phenazine with 1.4-benzoquinone, in the presence of nitrobenzene). Georg Kranzlein, Heinrich Greune, and Heinrich Vollmann, of Hochst-on-the-Main, Ger., assignors, by mesne assignments, to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,853,362, Apr. 12, 1932.

Dyestuffs of the Phenazine Series and Process of Preparing Them. (Yield green to yellow tints; comprises, for example, the reaction of 1-hydroxynaphthalene-3.4-phenazine with 1.4-naphthoquinone dissolved in ortho-dichlorobenzene. A continuation in part of U. S. application Serial No. 7390, filed February 6, 1925). Georg Kranzlein, Heinrich Greune, and Heinrich Vollmann, of Frankfort-on-the-Main-Hochst, Ger., assignors to General Aniline Wks., Inc., No. 1,854,045, April 12, 1932.

Dye Materials and Process for Making the Same. (Relates to the preparation of a dye material in the form of a thin sheet which may be readily bound into a book or booklet form so as to be immediately available for dyeing, bleaching, or stripping, as the case may be). Maurice Aisen, of N. Y., N. Y., No. 1,854,363, April 19, 1932.

Bleaching Methods and Agent. (A mixture of peroxides of the halogenated substitution products of the fatty acids contained in a natural fatty material.) Philip E. Rollhaus, of East Orange, N. J., and William B. Stoddard, of Stamford, Conn., assignors to Pilot Laboratory, Inc., of Arlington, N. J., No. 1,854,764, April 19, 1932.

Monoazo-Dyestuffs and Their Manufacture. (Prepared, for example, by coupling 4-amino-1-methylbenzene-2-sulphoethylanilide with 2-amino-8-naphthol-6-sulphonic acid; dye wool from acid baths clear yellowish-red to red tints of excellent fastness to light, perspiration and fulling.) Oscar Knecht and Theodor Wirth, of Basel, Switzerland, assignors to the Firm Chemical Works, formerly Sandoz, of Basel, Switzerland, No. 1,854,846, April 19, 1932.

Azo-Dyestuffs and Process of Making Same. (Produced from 1:4-naphthol-carboxylic acid ethyl ester; dye acetyl-cellulose, acetate silk or cellulose varnish, such as Zapon varnish, red orange tints of a remarkable purity and fastness, and the corresponding dyestuffs from diazo-paranitrobenzene dye the Zapon varnishes red tints very fast to light.) Friedrich Felix and Fritz Straub, of Basel, Switzerland, assignors to Society of Chemical Industry in Basle, of Basel, Switzerland, No. 1,854,894, April 19, 1932.

Manufacture of Water Soluble Azo Dyestuffs. (Comprises diazotizing the sulfamic acid derived from beta-amino-anthrahydroquinone-9.10-disulfuric acid ester, and coupling it with the ortho-anisidide of 2.3-hydroxynaphthoic acid.) Josef Haller, of Leverkusen-Wiesdorf, and Georg Rosch, of Cologne-Mulheim, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,855,289, April 26, 1932.

Nitrogenous Vat Dyestuffs. (New condensation products of halogen or nitro anthraquinone compounds with addition of acid fixing agents or condensing catalysts or both, in the presence of high boiling solvents; 75 examples, 29 claims; yield various shades on vegetable fiber, ranging from blue to grey to black to violet). Max Albert Kunz, of Mannheim, and Karl Koeberle, of Ludwigshafen-on-the-Rhine, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,855,295, April 26, 1932.

Production of Brown Vat Dyestuffs of the Diazine Benzanthrone Series. Paul Nawiasky and Alfred Ehrhardt, of Ludwigshafen-on-the-Rhine, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,855,306, April 26, 1932.

Azo Dyestuffs. (New vat dyestuffs, of various tints fast to kier-boiling and light, produced in substance as well as on the fiber, are obtained by diazotizing 2.3-dichlor-4-amino-1-methylbenzene and coupling the diazo-compound with an arylamide of 2-hydroxynaphthalene-3-carboxylic acid.) Hermann Wagner, of Bad Soden, Ger., Otto Sohst, deceased, late of Hochst-on-the-Main, Ger., by Adele Sohst, administratrix, of Hochst-on-the-Main, Ger., Carl Seib, of Hochst-on-the-Main, Ger., and Wilhelm Schumacher, of Sossenheim, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,855,328, April 26, 1932.

Production of Vat Dyestuffs. (Consists in condensing a tetrahalogen-2.2'-dibenzanthronyl with an aminoanthraquinone; yield black to violet shades on cotton.) Hugo Wolff and Max Albert Kunz, of Mannheim, and Karl Koeberle, of Ludwigshafen-on-the-Rhine, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,856,203, May 3, 1932.

New Secondary Trisazodyestuffs. (Obtained, for example, by coupling p-aminosalicylic acid with 1-naphthylamine-7-sulfonic acid in a weak acid solution; further diazotizing and coupling with the hydrochloride of a-naphthylamine and isolating and coupling with 1.8-dihydroxy-naphthalene-4-sulfonic acid; dye cotton bluish grey shades of good fastness to light.) Ernst Fellmer and Heinrich Hoyer, of Leverkusen-on-the-Rhine, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,856,211, May 3, 1932.

Process of Making Vat Dyestuffs of the Anthanthrone Series. (Comprises halogenating anthanthrone in an aqueous suspension in the presence of a carrier selected from the group consisting of I, Fe Cl_3 and I Cl_3.) Richard Herz, of Frankfort-on-the-Main, and Werner Zerweck, of Frankfort-on-the-Main-Fechenheim, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,856,215, May 3, 1932.

Technical Notes from Foreign Sources

Loss of Weight in Peroxide Bleaching of Cotton

W. Schramek and C. Schubert—Monats. f. Textil-Ind. 46, 313 (1931).—The use of hydrogen peroxide as a bleaching agent for both cotton-yarn and cotton weaves has greatly increased of late years, and has gained its favor for two reasons: the ease in attainment of the technical effect of the most careful kier-bleach process, and the appeal of its scientifically more rational basis. Although its use is still spreading, some objections have been raised against its value; the relatively high cost of hydrogen peroxide, the total abandonment of any chlorine bleaching in plants where the peroxide method has been received with enthusiam (it being suspected by some that the goods would ultimately yellow unless subjected to chlorine-bleaching to some extent at least), and lastly, that no boiling is involved, it being considered that kier-boiling is necessary to establish the desired "hydrophility" (capability of being wetted out easily) of the goods; i.e., it was believed by some that cotton goods, not kier-boiled, would not readily wet out when subjected to necessary laundering, when worked up into goods requiring laundering frequently. Further, it was known that goods bleached by peroxide did not lose so much weight in the process as was the case with kier-boiled goods, and this was suspected to be due to less complete removal of the natural incrustations of the cotton fiber, that is, the peroxide-bleached goods might look white, but were really imperfectly bleached. These objections were doubtlessly due to the first-practised method of using cold or cool or lukewarm peroxide with a weakly alkaline usually ammoniacal, reaction. With the change in working-methods, passing over to the modern, hot, strongly caustic bleach-bath, they have lost their significance; under the old conditions they were valid objections, but now they no longer apply.

The yarns and weaves, bleached by the modern method, with hydrogen peroxide, do not yellow at all more easily than do the kier-bleached goods. They possess very great hydrophility, and weaves which have been properly so bleached are most decidedly suited for printing. Their "feel" is better, the finished goods have a distinctive finished appearance, and keep in storage in good shape longer, than do the goods bleached by the kier-bleach method. It is true that the cost of chemicals is greater than in the case of the kier-bleach method, but the time necessary for the operation is not more than one-half; and any saving in cost of labor is by no means to be lightly regarded nowadays.

It should be kept in mind, that, by boiling of cotton goods in alkaline solutions under pressure, not only the actual "foreign" matter (from the viewpoint of the consumer of the finished goods), as seed-integuments and colored incrustations, are destroyed, but that, in addition, the caustic alkali, acting at a high temperature, also dissolves certain normal constituents of a clean cotton fiber, whose removal is not at all necessary for the breaching. Since there was no other way to destroy the seed-integuments in the raw cotton except to subject the material to alkaline treatment at a high temperature, the loss in weight of the cotton, part of it unnecessary, had to be taken into account in commercial agreements. It is only comparatively recently that it has been found that, by addition of oxidizing agents to the caustic alkali, the concentration of the alkali and the working temperature can be decidedly lowered. Activin, for example, is a substance which makes this possible. But only the use of the hydrogen peroxide bleach has made it possible to omit the boiling under pressure with caustic alkali, and to diminish the temperature of the alkaline purification of the fiber to 80°-90° C. Even at this lowered temperature the integuments and colored incrustations of the raw fiber are completely destroyed and dissolved away; even in the first bath of the two-bath system a white is attained which is almost pure and does not after-yellow. And, owing to the lower temperature employed, the loss of structural substance of the fiber is only slight, compared with that encountered in the kier-process.

The rest of the paper consists of a tabulation of the figures of comparative tests of the two methods, and a short discussion of the figures cited.

Dyestuffs Containing Chromium

German Patent No. 441,533 (12/III/'25)—*Gesells. f. Chem. Ind. in Basel*—Consists in the reacting together of an azo-dyestuff, into which chromium has been substituted by the now familiar methods, with a triaryl-methane (basic) dyestuff, which itself is capable of taking up chromium under proper conditions. The reaction consists simply in warming together aqueous solutions of the dyestuffs in proper proportions, and may be so carried out as to produce an ultimately solid dyestuff for storage, sale, later use, etc., or in the dyebath in which the new compound is to be used immediately after synthesis. The products are new compounds, the two component dyestuffs being apparently linked together through the chromium atoms. They dye, from a bath containing sulphuric acid, in fast and level tones. Still again, the combination may take place by dyeing one of the components upon the fiber, and then redyeing the material in a bath containing the other component. Five examples are given.

Dyestuffs Containing Chromium

German Patent No. 445,888 (7/VII/'25)—*Gesells. f.*

Chem. Ind. in Basel—Azo dyestuffs are first produced by coupling unsulphonated o-hydroxy-diazo compounds of the benzene series to unsulphonated 1-aryl-5-pyrazolones (one of the two components must contain at least one sulphamide group); and the dyestuffs so obtained are treated as usual with chromium compounds which are capable of introducing chromium into the molecule. The products are acid dyestuffs, which dye wool, for example, orange (especially loose wool or combed wool) in very level tones fast to light and fulling. Six examples are given.

Vat Dyestuffs (Benzanthronyl Series)

German Patent No. 435,477 (10/V/'24)—*I. G. Farben-Ind. A.-G.*—2-2'-Dibenzanthronyl is nitrated, and in some cases the nitro group or groups then reduced; in either case the product is subjected to the usual alkaline fusion, whereby vat dyestuffs are produced. The one example given covers a product dyeing cotton, from the vat, gray-blue to black.

Vat Dyestuffs (Benzanthronyl Series)

German Patent No. 436,534 (12/VIII/'24) (*addition to G. P. No.* 428,185 *of* 12/VIII/'24)—*I. G. Farben-Ind. A.-G.*—In this supplementary patent, the acidyl derivatives of amino-dibenzanthrones referred to in the original patent are treated with alkylating or aralkylating agents. Two examples are given, covering blues; one, a marine blue from a pure blue vat, the other a blue-gray from a blue vat; the latter product, if purified by recrystallization, then dyes a strong greenish-blue. Each is very fast to chlorine.

Dyestuffs for Cellulose Acetate or Wool (Anthraquinone Series)

German Patent No. 438,934 (25/VII/'24)—*Scottish Dyes, Ltd.*—Diphthalimino-anthraquinones, especially the 1-5-isomer, are nitrated, and their reduction products hydrolyzed, or the nitro-products reduced and hydrolyzed, or these two operations carried out simultaneously. The products are useful for dyeing cellulose acetate, in fibers, films, etc., blue, and are also suitable for dyeing wool. Four examples are given.

Artificial Silk—Its Significance as a Specifically Modern Textile-Material

Dr. Adolf Gebhardt—Deutscher Faerber-Ztg. 67,478 (1931)—When a textile material, in spite of unfavorable world-conditions, continues to gain increasing importance to the producer, processer, and consumer, and to the public in general, it is not without interest to look somewhat into the causes and progress of such a condition.

When artificial silk, using the term in a general sense, was brought upon the market by competent producers, it rapidly became a quality-product of the first importance. The general fall in prices of raw material affected the present product, especially, in a pronounced manner. Merely in the interval from 1924 to 1929, the price of artificial silk fell, on an average, by about 50%, and this tendency has continued since that time. When the great producers, in spite of all the unfavorable events in the artificial silk market, which have most recently led to earnest efforts toward syndicate-formation among the selling-agencies, and in the plants as well, can look ahead, in spite of all the discouragement of recent years, with a fundamental optimism, to a future of further development of the industry, such a point of view must have grounds which can be justified. From the standpoint of the originally purely technical expectations of the producers, we have experienced something quite remarkable in its nature. The first technical efforts were directed intensely toward production of a fiber which should be completely identical with the natural silk, in its behavior and in all its physical properties. These efforts have cost, even up to the present time, much labor, time, and capital. We have now, in a certain sense, come to the close of this chapter technically, at least, as far as the common fundamental materials are concerned. It must be added here that a complete physical identity, in the ideally conceived sense, can be attained in the case of no natural fiber whatever. This circumstance, however, is no disadvantage, but in a certain sense has become a distinct advantage in favor of the artificial fiber. What was feared from the fact that we found ourselves unable to imitate slavishly any natural fiber, has not come to pass; but rather we have gained a type of fiber which, standing on its own ground, has been able to establish itself in a permanent position in the textile field, and able to meet completely the specific demands made upon it by the consumer. Artificial silk as such (not as a mere more or less successful imitation of natural silk) has acquired its own characteristic psychological status, which is adjusted to certain demands of the modes of our day, which we no longer care to leave unsatisfied.

Because of the fact that artificial silk fiber differs from that of other textile materials, physically, if not both physically and chemically, differential effects can be extended in scope by the characteristic optical properties of the artificial fiber. In accordance with the demands of the prevailing mode, artificial silk can be varied in its properties, as a result of the modifications possible in its code of synthesis, in a higher degree than can a natural fiber, upon which we can exert no such influence in its formation. Cotton can be changed rather decidedly in some of its properties through mercerization, and natural silk through weighing. As to other possibilities, one can point merely to variations in the combination of different kinds of fiber, and to the mechanical treatment of the surface-luster, as the only possible means of satisfying the demand for modification, in response to the varying calls of fashion.

The phenomena of life upon the boundary-planes of great cultural units are, as is seen even in our present times, full of a natural unrest, and their unavoidable by-product is the rapidly changing demands of fashion, as their outward form of expression. The great importance of artificial silk lies in the fact that it forms an instrument specifically responsive to this involuntary urge. To make it fully so, a whole series of types of

artificial silk has been originated, any one of which displays its own proper characteristics. Some of these modifications stand strikingly close to natural silk itself; in the case of others, there has been an endeavor to work out the characteristics of other, natural, fibers; again, some form types of individual, specific properties, so to say, like themselves alone.

Nitro-silk, which formerly played so important a role, is now being produced in only a subordinate degree, because of the uneconomical nature of the process. Cuprasilk, better known, perhaps, as Bemberg silk, Cellvag, etc., successfully capitalizes its peculiar characteristics as a quality product through its toned luster. Viscose silk is more and more becoming the universal product. There are included in it as a class certain forms whose properties are all in favor of the consumer. In Germany, and to some extent abroad, the forms of it best known are, perhaps, Glanzstoff, Agua silk, Travis silk, Casema, Zehla silk, etc. Travis silk possesses a specially fine-fibered character. A subordinate kind of viscose silk is the so-called Celta, or Air, silk, which contains a hollow air-space within the fiber, due to a special mode of synthesis; and this air-space increases the warmth of articles of clothing made from it. Acetate silk, too, is a quality product, whose properties in some directions closely approximate those of natural silk. Statements are being made, too, that artificial silks of still other types of synthesis, as the Lilienfeld silk, are about to begin competition with the older types, though a decisive opinion on this matter cannot as yet be given. Of interest at present, in a special way, is the method of preparing artificial fibers for spinning, the so-called staple fiber (Sniafil, etc.), which in principle rests upon the viscose method. These products are not worked up into endless filaments, like the ordinary types, but cut into staple, and then worked up into yarn by spinning, similarly to the natural fibers. Vistra silk is of this sort. It is conceivable that, as a result of the differing structures of the fiber as used, new properties in the finished yarn may result. And most recently still, other forms of artificial silk, which again depend upon the viscose method—artificial straw, artificial horse-hair, and an artificial silk which contains a metallic precipitate (metal yarn Bayko yarn)—are being introduced into commerce.

The optical properties of the above products can be greatly varied by the matting process, which seems to be extending its usefulness. But the value of such a product is as yet problematical, since some forms of such products do not stand storage well, or the "feel" of the goods suffers through improper methods of working up.

The great possibilities of extended combinations of the different kinds of fiber with the natural fibers and with each other have already been mentioned. In combinations with other kinds of artificial fiber, acetate silk is especially valuable. In this connection, it was not so many years ago, that the artificial fibers could be used only in the woof, not possessing sufficient strength for use in the warp as well. But steady improvement in the quality of fiber, methods of preparing the yarn, finishing, etc., make it now possible to construct the whole weave of artificial fiber. And the technique of the whole artificial silk fiber industry is still being developed.

Sulphur Dyestuffs

Georg Rudolph—Monats. f. Textil-Ind. 46,289 (1931)—The first section of a paper, of apparently general and full nature, on the characteristics and manner of application of the dyestuffs of this group. The present installment gives a good list (unfortunately for general usefulness, they are all, of course, of German origin, as, after all, is quite proper in a German journal—we cannot complain of it) with brief but detailed information about the characteristics of each, and another section, which takes up in the same compressed but full manner the conditions of working—water, dyeing apparatus, bath-ratios, solution of the dyestuff, Glauber salt, etc.

Such articles as this would of course be valueless to an experienced dyer who is working more or less regularly with sulphur dyestuffs; such a dyer would have learned all such matters by experience. But (and it is an important exception) there are probably very few dyers in such a position, and there are very many more who have not yet had sufficient experience to work comfortably with this group. So that, though in this installment of the paper there is doubtless little, if anything, new, or presented in a new way, the paper should prove of great help and value to many who are not very sure as yet of their ground. And it should be remembered, by the few who can honestly call themselves experts, that one of the true functions of a journal is to help train the younger and less experienced readers. The paper is of great usefulness.

Fireproofing of Weaves

R. Manschke—Monats. f. Textil-Ind. 46,243 (1931)—(*A review and discussion of an article appearing in Chem. Trade Journal and Chem. Eng.* 1930, *p.* 426)—An interesting summary of the longer paper forming its basis.

The principal part of the work cited was carried out with borax-boric acid mixtures. An interesting finding runs as follows: "In the course of an investigation of binary mixtures, it was found, for example, that borax hinders the spread of combustion only when it is present in quantities of about 60% on the weight of the material, and that boric acid itself is without such action even when present to the extent of 90%; but that a mixture, of equal parts of borax and boric acid is effective when present to only 10%. Further investigations established the fact that by use of a mixture containing 30% of boric acid and 70% of borax, 6% by weight would fireproof the material. Such a treated material suffers no deterioration worth mentioning when left exposed to the sun, the softness and flexibility of the goods remains unaffected,

and, further, all danger of bacterial action or moulding is out of the question. Only, the protective mixture will be washed out if the goods are wetted.

Printing of Viscose and Cupra-Silks; What Points Must Be Guarded Against

K. Swoboda—Kunst-Seide 13,60 (1931)—Printing of artificial silk weaves is one of the modern developments in the utilization of artificial fibers. In printing upon weaves of purely artificial silk, quite a number of classes of dyestuffs is successfully used; the basic, Janus, mordant, developing, and vat dyestuffs, for example. Substantive dyestuffs are seldom employed, and the sulphur colors still less. Although the methods used for printing upon cotton are in a general way applicable to the present case, there are some points which care or even modification are needed. First of all, since artificial silk swells strongly upon being wetted, such goods need to be specially prepared, if the outlines of the print-pattern are to be kept sharp, for otherwise, printing of a paste upon ordinary, dry, artificial silk fabric would bring about a running-out of the edge of the pattern into the surrounding fibers. This can be prevented by pretreatment of the goods with aluminum acetate, best in a padding-machine, the acetate liquor at 8—12 B. If the so padded weave is then only moderately rinsed, and dried at a moderate temperature, the power of swelling and the capillarity of the fiber are greatly diminished, the pattern prints with a sharp edge, and the subsequent steaming does not provoke bleeding. In preparing this acetate solution, however, one must be sure that it contains no inorganic acids (does this mean free acid, or in the form even of aluminium or other salts?), and the degree of basicity is also of importance. Too high a content in free acetic acid is liable to weaken the fiber in the subsequent drying and steaming; and too basic an acetate is liable to throw down aluminium hydroxide upon the fiber, leading to the later formation of spots, non-lustrous patches, or some such alteration in luster or feel.

As will be noted from the above, organic acids, rightly considered so harmless in case of the natural fibers, are with the artificial ones a source of danger, though solely from their weakening effect upon the artificial fiber during drying and steaming of the printed goods. As the printing pastes are usually acid in nature (necessary either for holding the dyestuff in solution, or for preventing precipitation of it as a lake), the degree of acidity of the paste likewise requires careful oversight. Lactic acid is the least harmful of the organic acids commonly used; it seems to have no weakening or other deleterious effect upon the fiber, even at a high concentration. Formic acid is decidedly and definitely dangerous. In all the above, what has been said applies particularly to knitted goods; weakening and subsequent rupture of a single filament in knitted goods leads to disaster easily to be imagined.

In the pastes, the thickening agents, too, need attention. If the starch or gums are well boiled up, they impart a desirable additional strength to the goods during subsequent working up; but the addition of hygroscopic agents, glyecine or glycerol, is to be recommended, to prevent undue drying out and hardening of the printed areas, and to facilitate the later washing-out.

When mordant dyestuffs are employed, the mordants must be pure; i.e., contain no inorganic acids (see above). This point, however, is of importance in cotton printing also. And, again, the degree of basicity is important, and once again, because of the danger of the presence of too much organic acid. The steaming alone, may also work harm, if carried out at too high a pressure and temperature, even though there is no dangerous amount of organic acid present.

As to the vat dyestuffs, they are to be applied exclusively by the potash process. The stronger alkalies have too great a disruptive effect upon the fiber under ordinary conditions; and their effect would be greatly heightened by the conditions prevailing during steaming.

Reference has been made repeatedly to the steaming process, whose purpose, of course, is to fix the dyestuff upon the fiber. Under some circumstances, it alone is not without influence upon the fiber, as mentioned previously. Short steaming, at only slight overpressure or at ordinary pressure, is usually without influence upon the fiber, either physically or chemically. It is even to be observed that such a careful steaming may notably increase the tensile strength and elasticity of the fiber. But longer than perhaps 10 minutes of steaming again decreases these values, and the white fiber takes on a yellowish, or even brown, tone. Any subsequent dyeing, also, will show that an oversteamed fabric has lost some of its former affinity for dyestuffs.

Dyeing of Stockings

Dir. Svarovsky—Kunst-Seide 13,58 (1931)—Since the fashion of short skirts has become so general, stockings are worn at least as much for ornamental clothing as for protection of the legs—possibly more so for the first purpose than for the second. And accordingly the materials of which stockings are now being manufactured are of the more ornamental sort—not so much cotton for cheapness, or wool for warmth, or silk for a restrained display, but the newer artificial fibers, with their manifold possibilities of homogeneous or compound weave-effects.

In the weaving or knitting of the stocking, the artificial silk fiber must be so finished (more properly, actually lubricated), that the unavoidable friction encountered in passing through the needle or other parts of the machinery shall be cut down to a minimum; this is the more necessary, because the artificial fibers cannot be, in general, claimed to possess as great a tensile strength or resistance to friction as do the natural fibers—in general, at least, as yet. For impregnation of the fiber with this lubricant, the machines built specially for winding artificial silk carry between each spool and the winder special

impregnating vessels, through which the yarn must pass, and which contain the lubricating agent in a liquid state. In some cases, the lubricant is solid paraffin, from which the yarn takes up a sufficient quantity by passage over the paraffin mass, which is generally in the form of a roll or cylinder of the material. Such lubrication is absolutely necessary for the less costly sorts of artificial silk; and the materials used for the purpose are of the most varied kinds. As usual, some preparations contain components which are not only useless for the purpose designed, but may be actually harmful to the fiber. All the agents, good and bad, useful or useless for the purpose, impose difficulties upon the dyer and finisher, who must remove the finishing agent so that the knitted stocking can be properly wetted out and dyed. Uneven dyeings are very likely to result, and to lead to irritating controversies and claims for adjustment.

In simple justice, the dyer should be informed, before beginning his work, of the exact nature of the finishing agent, the lubricant, used, and, when possible, the source of the components of the preparation, if it is of compound nature, for the most important part of the process of the dyeing of stockings consists in the preparation of the goods—the degreasing or de-paraffining, wetting out, and softening, and all the other steps, should be carried out in one bath, in one treatment, if possible, and at as low a temperature as possible; for artificial silk goods will not stand much working, without unpleasant consequences ensuing. This preparation of the goods must be so carried out, that Bemberg and the ordinary viscoses, mixed with acetate silk and cotton, perhaps, either in mixture or in the different parts of the stocking, will all take up the cheap dyestuffs evenly, and correspond to the prescribed shade.

The apparatus employed in dyeing stockings has developed according to the peculiar needs of the case, and as an aid to increased production. Some of the requirements of an efficient dyeing-machine for the purpose are:

1—the possibility of a convenient and rapid loading with at least 50 kilos of goods to be dyed.

2—uniform circulation of the bath, with similarly uniform alternation movement of the goods during dyeing.

3—any solid matter separated during the dyeing must be capable of rapid and complete removal during the carrying out of the dyeing process.

4—introduction of steam into the apparatus, both direct and indirect steam heating, must be provided for.

5—the goods must not come into contact for an instant with any part of the apparatus during the dyeing, and must be kept moving freely in the bath, without either winding or reeling being resorted to.

6—removal of the dyed stockings must be capable of being done rapidly and conveniently, and under such conditions that the container holding the goods can be easily carried or moved to the rinsing apparatus, which must be located close at hand.

7—the apparatus must be easy to clean out, quickly and thoroughly.

Up to the present, three types of dyeing machines have been brought upon the market;—

a—a horizontal type, the stockings being laid loose in a cylindrical inner container, which is divided into compartments. This container is mechanically oscillated to and fro; its walls are perforated, to allow circulation of the bath. The surfaces of container and bath are of Monel metal. The circulation of the bath-liquor is good, but the stockings are almost constantly in contact with the metal walls of the drum. A rather expensive machine, owing principally to the use of Monel metal.

b—a vertical type cylindrical in shape. The lid is movable, and oscillated mechanically carrying upon its under surface wooden stocking-holder frames, notched. These holders are easily removable, and from them, by each notch, are hung 6-10 pairs of stockings, held together by a strand of strong yarn sewn through them. When the apparatus is fully loaded, these bundles of loose stockings are suspended with the tops of the stockings about 5-8 cm. below the surface of the dyebath. The lid is, of course, easily removable by a vertical rise; in operation, the bath is kept in motion by leading in live steam at the bottom, the inlet being guarded by a perforated wooden false bottom. The stockings do not come into contact with the walls of the apparatus at all. The chief disadvantage of this type is the time consumed in loading and unloading the charge of stockings.

c—a vertical type, consisting of a galvanized iron cylindrical tub, with a vertical rotation shaft passing downward through it, and actuated by a drive underneath. This vertical shaft, within and at the lower part of the outer tub, carries a sort of false bottom, attached to and rotating with the shaft; this false bottom is cone-shaped; upon this cone fits the lower basket, whose bottom is conical and fits upon the carrying-cone of the bottom; a series of these conical baskets, in which the stockings are packed loosely, is built up around the shaft. The bath is heated by two copper steam-coils, one for indirect, the other for direct, steam. During operation, the vertical shaft is kept in reciprocating motion, and the stockings are maintained thereby in a partially loose circulation, though touching the baskets more or less. The circulation of the dye-liquor is good. As the top of the uppermost basket is below the surface of the bath, the foam can be removed without its causing trouble during the dyeing. The apparatus is open to the air.

Dyeing by hand seems to be still the only dependable method, in the opinion of those who have tried out the above types of machine in comparison with hand-dyeing. Reasons for this preference are rather the disadvantages offered by even the best and most modern machinery; the trouble and time involved in loading and unloading, the impossibility of getting rid of the foam conveniently and effectively, and the balling together of the goods in the machines in which the stockings are suspended separately. The type of machine in which the goods are thus exposed to the dye-liquor seems, on the whole, to be the best of any; a desirable improvement would be the

addition of a clip-on device, so that individual stockings could be put under light tension by clipping at top and bottom; but this would involve still more labor and time in the loading and unloading.

A comparison of the value of the two methods would, for example, show that, by the hand method, 50 kilos of artificial silk stockings, with two skilled hand-workers cooperating, could be dyed satisfactorily in about two hours, exclusive of the centrifuging and drying; machine dyeing would, for the same quantity, require about ½ hour longer, i.e., ½ hour more of labor to be paid for, beside the cost of operating. Some of the all-metal machines require the use of such expensive dyestuffs as the Sirius colors; when the container is of wood, cheaper types of dyestuff can be used.

It must be admitted that machine-dyeing offers some advantages over hand-dyeing, but the bulk of advantage still lies with the old, hand method. The machines on the market need further development before they can be looked upon as satisfactory improvements over the simple apparatus of hand-dyeing.

Sulphur Dyestuffs

Georg Rudolph—Monats. f. Textil-Ind. 46,324 (1931)—The second and closing section of the paper, the first part of which was noticed in these columns recently. The present section consists of details of the practical application of different types of sulphur colors, with notes upon aftertreatment.

Conversion of Starch into Dextrine in Finishing

Monats. f. Textil-Ind. 46,324 (1931)—In the correspondence columns of the Journal cited, a question was asked relative to the possibility of potato starch, contained in a weave as the result of finishing, being converted to dextrine by final dry-heat. Four of the consulting experts of the Journal reply as follows:—

a—Through the action of considerable heat, potato starch does become converted to dextrine. In Depierre's "Appretur der Baumwollgewebe," it is stated, on p. 35, "Starch is used in finishing simply for its change into dextrine. Through drying, the paste loses water, and there remains an outer coating of dry starch upon the fabric, which is partly converted into dextrine through the heat of the drying-cans or the calender." Drying temperatures of 60°-80° C. can certainly start the dextrinization, but cannot complete the process to any practical extent. The reaction proceeds slowly; since the goods are exposed to heat for only a short time, damage to the goods is not to be feared. As to whether dextrine has actually been formed, one may test with tincture of iodine; if dextrine is present, the white goods are colored red-brown; starch takes on the characteristic blue-violet color.—H.B.

b—In order to convert potato starch into white dextrine, the duration of the hot-drying is much too short. If dextrine is definitely desired, it is better to prepare it specially in suitable apparatus by roasting the starch with a trace of nitric acid at about 1 atmosphere overpressure, in about ½ hour. For brown dextrine, the heating and stirring must be continued longer.—E.J.

c—Through the heat of the drying-cans, a part of the starch in the finish can certainly be converted into dextrine. Yet the amount of the dextrine formed is doubtless so small, that in the technical sense it may safely be ignored. For a satisfactory conversion of starch into dextrine, a temperature of about 200° C. is required, as in the industrial preparation of brown dextrine, which is obtained by this process of roasting, and so assumes the characteristic brown color.—Zoller.

d—If the finishing mass is prepared according to directions, that is, is correctly boiled up, so that it can penetrate well into the goods, then a transformation of the starch into dextrine during the drying is hardly possible; if it does take place, then the goods were not properly rinsed, so that the finishing agent lies directly upon the surface of the goods, which is not what was desired.—Although I have been looking for the occurrence of the formation of dextrine for years, no case has as yet come under my notice, so that the question appears unimportant.—ph.

—It will be noticed that the above comments agree as to the possibility of the conversion taking place, to an initial extent, at least. A careful study of the question might well be in order, perhaps centering upon the point—Just what is the nature of the starch-glaze surface upon some calendered weaves, chemically?

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